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ARMSTRONG LABORATORY

FINAL REPORT FOR SOURCE TEST MEASUREMENT OF NITROGEN OXIDES, SULFUR DIOXIDE, CARBON MONOXIDE, VOC, AND PM10 EMISSIONS ON GAS TURBINE #2 AT ONIZUKA AIR FORCE BASE SUNNYVALE, CALIFORNIA

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FOREWORD

This report was prepared by Pacific Environmental Services, Inc. (PES) using due and ordinary care and in accordance with the scope of work identified in the Professional Services Agreement, Purchase Order, or other written/verbal request.

Any measured contaminants and their concentrations detected or identified in this study are for the sample(s) obtained or for the observations made at the time(s) and location(s) referenced in the report and may not represent other times, locations, or contaminants and their concentrations.

Except for the tests and observations conducted by PES, no attempt was made to check for compliance of present or past owners or operators of the equipment, plant, or site with federal, state, or local laws and regulations.

The information provided in this report, including any drawings and specifications, was prepared solely for the use of the identified client and any use by any other party shall be at their own risk.

The project work was conducted by Steven M. Hernandez, Robert T. Nguyen, and S. Hugh Brown under the direction of S. Hugh Brown.

Approved: S Hugh Brown

S. Hugh Brown, Director
Air Quality Testing

A-1

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Onizuka Air Force Base currently has twelve gas turbine generators which supply electric power for the entire facility. Heat recovery boilers are connected to each generator. Current plans are for the power plant to curtail its operation. Under current Bay Area Air Quality Management District (BAAQMD) rules and regulations, emissions credits can be banked and sold. Source testing is required to quantify the baseline emissions for each constituent potentially reduced.

Based on information obtained from the BAAQMD, source testing was conducted for nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOC), and particulate matter less than 10 microns (PM10).

Pacific Environmental Services (PES), a participant in CARB's Independent Contractor Program, was hired by the Air Force to perform the required source testing and data reduction. PES qualifies as an independent testing laboratory (no conflict of interest). The source testing was conducted by S. Hugh Brown, Steven Hernandez, and Robert Nguyen of PES on December 3, 1993 and January 12, 1994.

CHAPTER 2

EQUIPMENT AND PROCESS DESCRIPTION

All of the gas turbine generators were identical 750 kVA units that were manufactured by Solar and each consumed a maximum of 130 therms/hour of natural gas. Gas turbine #2 was equipped with sampling ports and a work platform and was used as a demonstration unit for all twelve generators. The turbine exhaust gases were routed under the turbine platform and over to the heat recovery boiler adjacent to the turbine on the same platform. The gases entered the boiler through a diverter/bypass damper at the base of the exhaust stack. When the damper was in the bypass position, the gases were routed straight up the stack to atmosphere. When the damper was in the closed position, the gases were routed horizontally through the boiler exiting the top and rejoining the stack just above the bypass damper. The location of the turbines on the base is shown in Figure 2.1. The gas turbine and heat recovery boiler are depicted in Figure 2.2. A copy of the Permit to Operate issued by the BAAQMD is located in Appendix A.

The source testing was conducted on gas turbine #2 at a constant load of about 570 KW with the heat recovery boiler damper set at 75% closed (25% bypass).

Figure 2.1
Plant Layout And Equipment Location

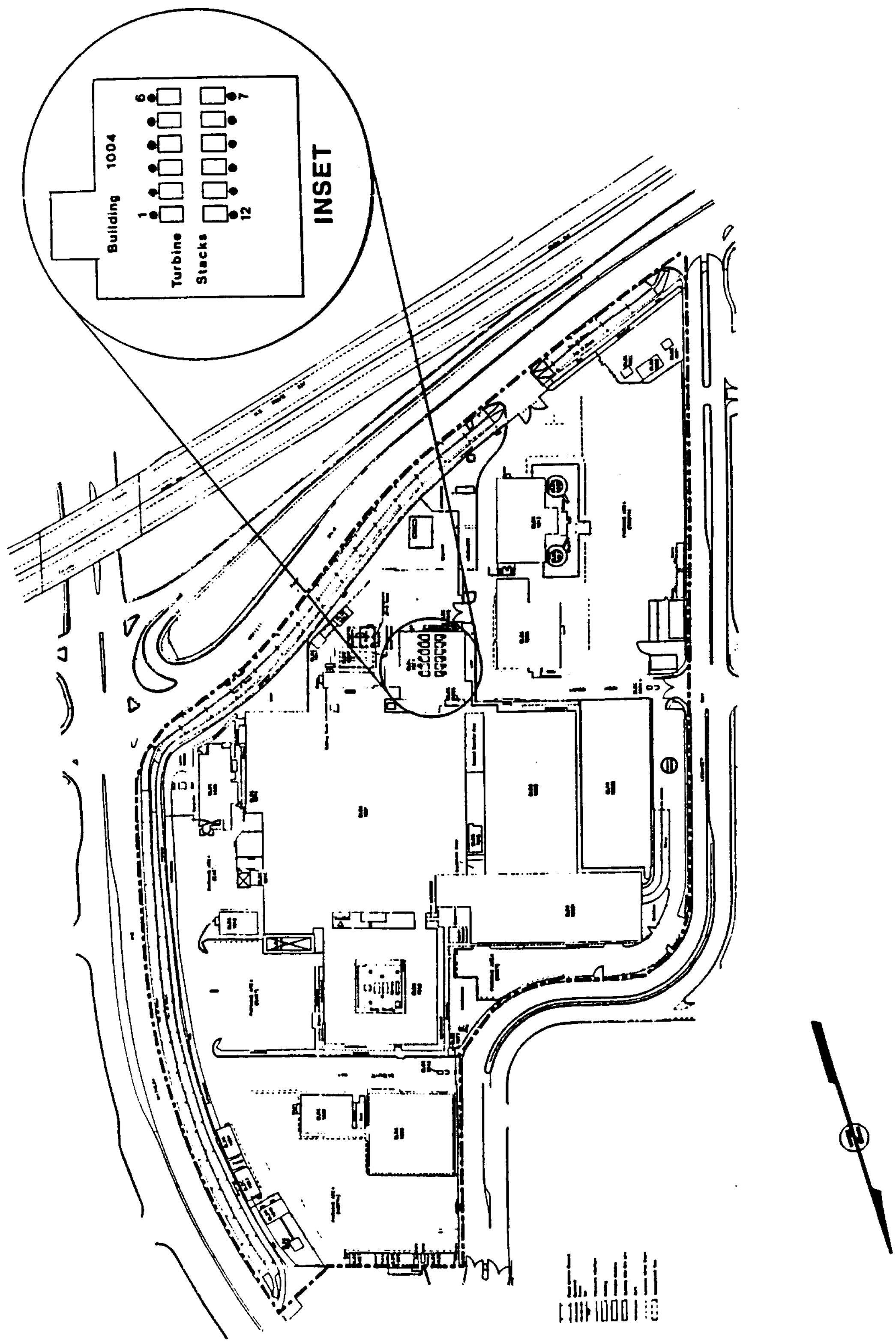
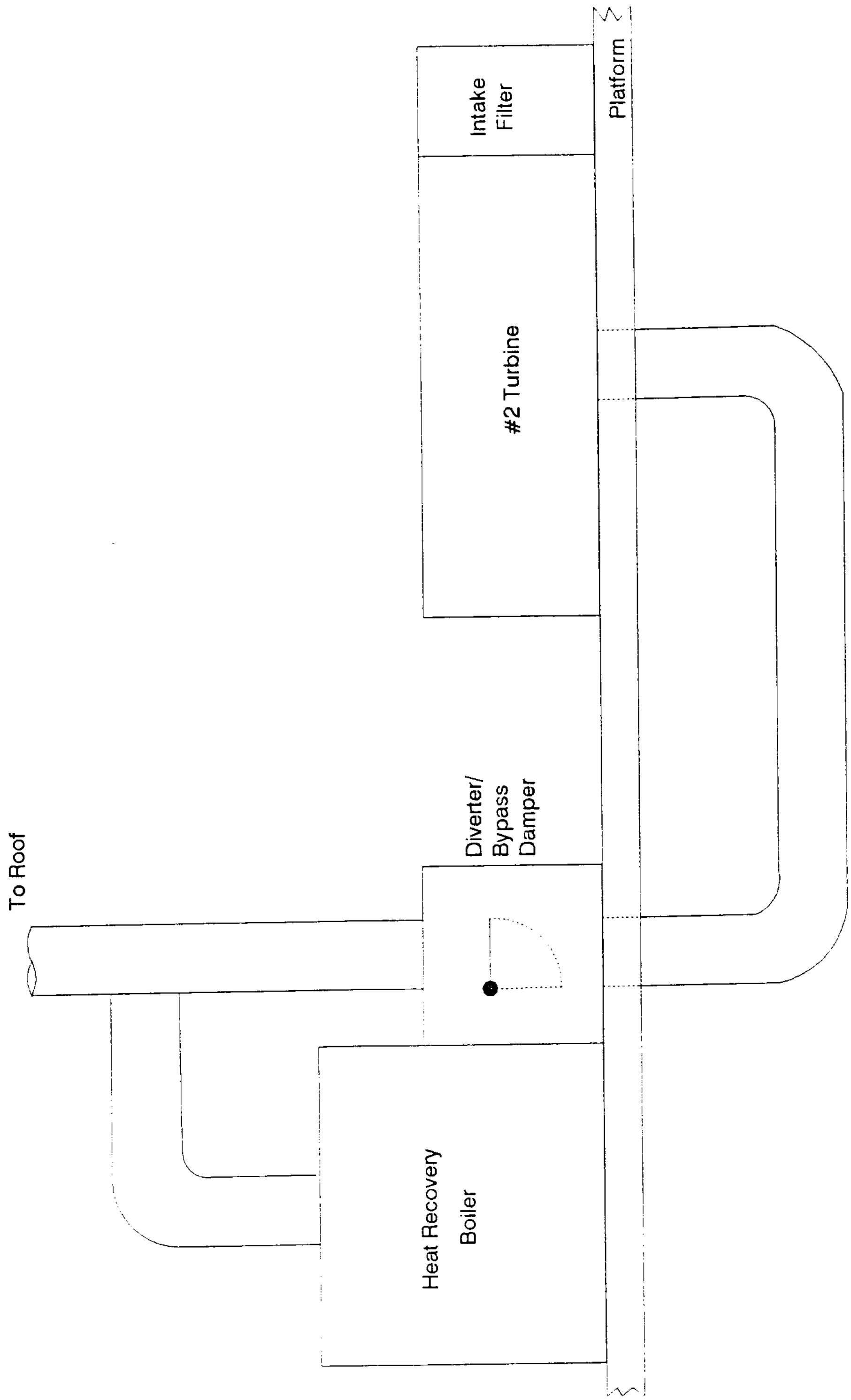


Figure 2.2
Schematic - Turbine/Heat Recovery Boiler Number 2



CHAPTER 3

TESTING METHODOLOGY

The approximate sampling port locations are shown on Figure 3.1. The number of traverse points required (4 on each of two diameters, 90 degrees apart) and their locations were derived from CARB Method 1. The sampling was conducted on the exhaust of turbine #2 at roof level during block load conditions. Triplicate tests were conducted for each constituent determined.

PM10

The PM10 emissions of the exhaust were determined by EPA Method 201A. The sampling train is shown in Figure 3.2 and consisted of a stainless steel nozzle, a 10-micron cut-off cyclone and an in-stack stainless steel filter holder manufactured by Andersen, a 48-inch glass probe, a 10-foot Teflon hose from the probe to the first impinger, two Greenburg-Smith impingers each charged with 100 mls of distilled water, an empty impinger, an impinger filled with silica gel, a 30-foot umbilical line, a vacuum pump, a dry gas meter and a calibrated orifice connected to an oil inclined manometer. Glass fiber filters were used in the filter holders. Each sample was collected isokinetically at a fixed sampling rate and the number of minutes sampled at each traverse point was determined by the ratio of the point velocity to the average velocity. The velocity and temperature were measured at each traverse point as it was sampled. Field data and calculation sheets are included in Appendix B.

The volume of the impinger solution and the weight of the silica gel were recorded before and after the tests in order to obtain the moisture content of the stack gas stream. All sample volumes and weights were recorded immediately on sample recovery sheets (Appendix B) during charging and sample recovery. Leak checks were performed before and after each test. The post-test leak check was performed after removing the cut-off cyclone so as not to disturb the particle catch.

After the test, the contents of the nozzle and cut-off cyclone (PM10+) were recovered by rinsing three times with acetone. The washings were placed in a 125-milliliter polyethylene container. The filter was placed in a plastic cassette. The contents of the cyclone exit and filter holder front (PM10) were also recovered by rinsing three times with acetone. The washings were placed in a separate 125-milliliter polyethylene container. The contents of each impinger set was placed in a 1000-milliliter polyethylene container. The sampling train was then rinsed from the 3rd impinger to the nozzle with the distilled water and the rinse was added to the sample. The impinger solution was saved but not analyzed. Disposable vinyl gloves were worn during sample retrieval to help prevent contamination.

Figure 3.1
Sampling Location - Turbine Number 2

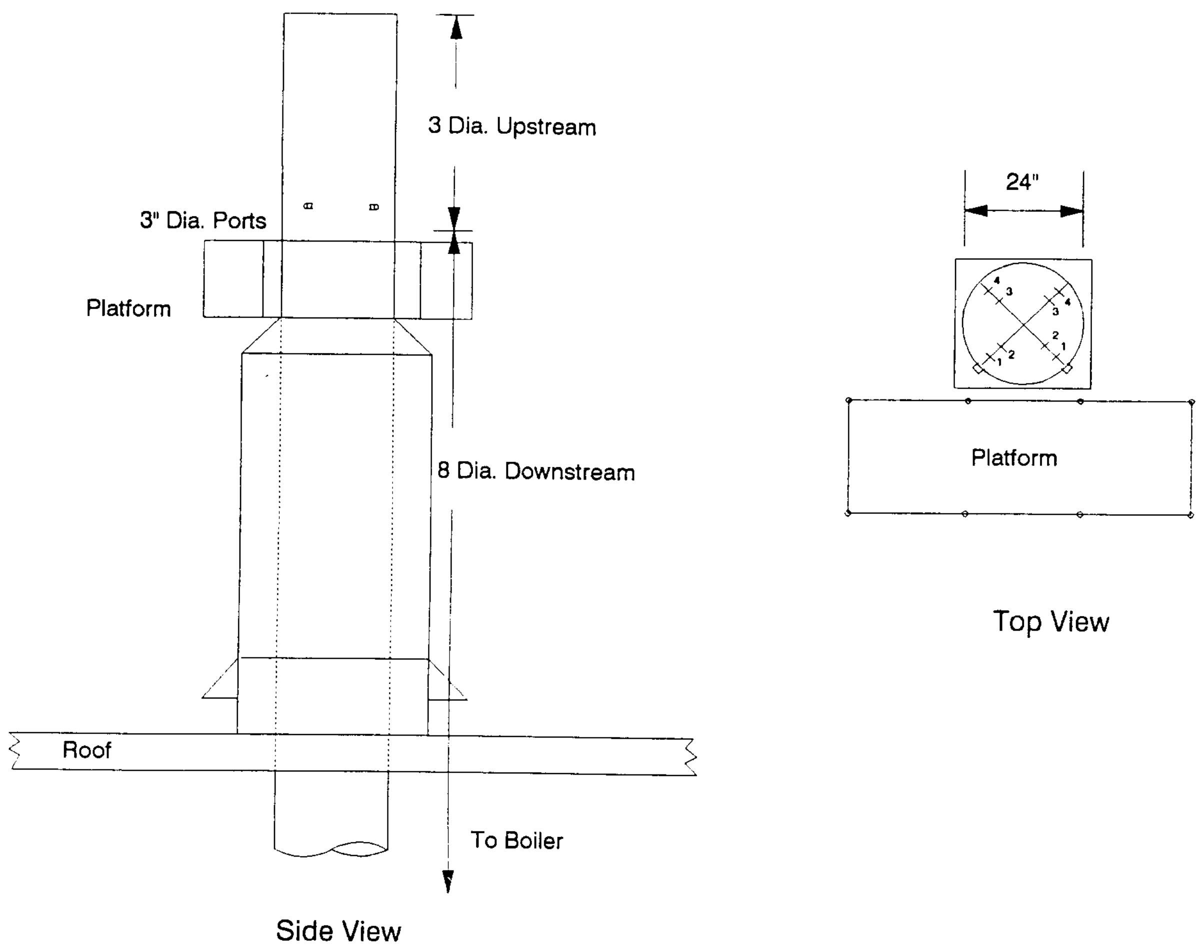
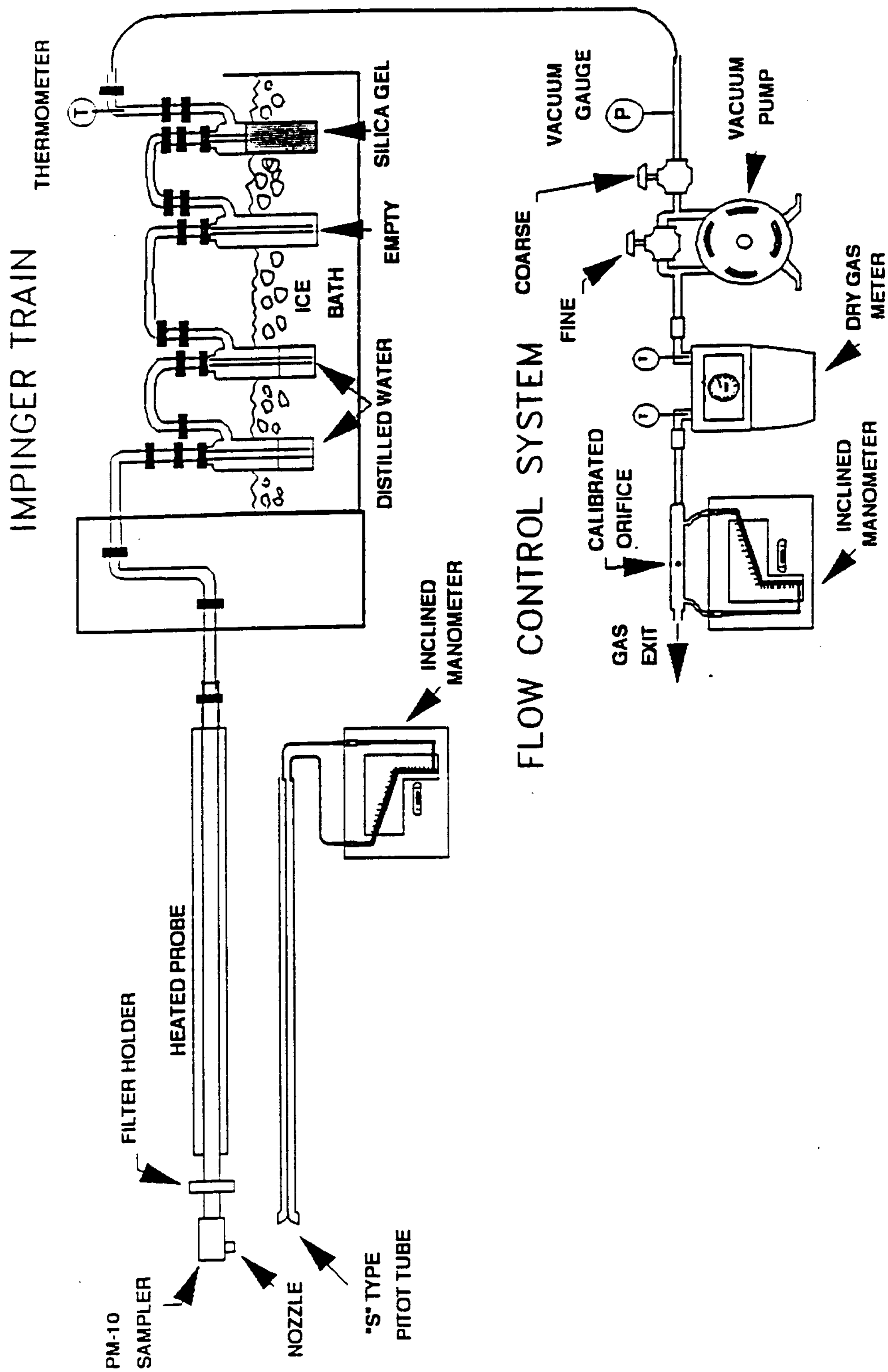


Figure 3.2
PM10 Sampling Train - EPA Method 201A



The particulate fractions were evaporated to dryness at 100 degrees Centigrade and desiccated to a constant weight along with the sample filter.

CONTINUOUS MONITORING

The turbine/boiler exhaust was monitored for VOC, CO, CO_2, O_2 and NO_X by CARB Method 100. Each test run was 60 minutes long. Rosemount Analytical Model 880 Infrared Analyzers were used to determine the CO and CO_2 concentrations. A Rosemount Analytical Model 755R Paramagnetic Analyzer was used to determine the oxygen concentration, and a Thermo Electron Model 10 Chemiluminescent Analyzer was used to determine the NO_X concentration. The output of the analyzers was linearized by the manufacturers. Table 3.1 lists the instrument specifications. Table 3.2 lists the calibration gases that were used specific to this job.

The continuous monitoring train for the above gases is shown in Figure 3.3 and consisted of a 3/8-inch stainless steel sampling probe, a 3/8-inch heated Teflon sampling line, a sample refrigeration/pump system, a glass fiber filter in a 47-millimeter stainless steel holder, and a sample distribution manifold. The distribution manifold was equipped with a series of 3-way valves with flow meters (rotometer style). One flow meter acted as a bypass, and the others were connected to the individual analyzers. The output of the analyzers was logged by a Yokogawa Model HR2400 multi-channel recorder and a Rustrak Ranger II data logger.

The NO_X analyzer was operated on a range of 0-50 ppmv with span gases at 10.4, 23.5, and 44.2 ppmv. The CO analyzer was operated on a range of 0-100 ppmv with span gases at 50 and 75 ppmv. The O_2 analyzer was operated on a range of 0-25 per cent with span gases at 11.0 and 19.0 per cent. The CO_2 analyzer was operated on a range of 0-5 per cent with span gases at about 2.0 and 4.0 per cent. Prior to the source tests, the suction side of the monitoring system was leak-checked at a full vacuum (greater than 20 inches mercury).

A bias check was made on each analyzer by comparing the response between the span gas introduced at the sample line tip and the span gas introduced directly to the analyzer to ensure a differential of less than 5 per cent. The analyzers were spanned before and after each test run with NIST traceable calibration gases from Scott Specialty, and with zero grade nitrogen.

The total hydrocarbons were determined on January 12, 1994 by using a JUM Model VE-7 total hydrocarbon analyzer that utilized a heated Teflon sample line and a flame ionization detector mounted in a heated oven. The sample line was maintained at 250 degrees Fahrenheit, and the oven was maintained at 180 degrees Centigrade. Since the gas stream was expected to have a low concentration of

Table 3.1
Continuous Monitoring Specifications

NO_x Chemiluminescent Analyzer - Thermo-Electron Model 10A	
Response Time	1.5 sec - NO, 1.7 sec - NO_x
Zero Drift	$\pm$ 0.5% after warm up (30 min)
Span Drift	$\pm$ 1% of full scale
Linearity	$\pm$ 1% of full scale
Accuracy	Derived from the calibration NO/NO_x $\pm$ 1% gas was used.
Output	NO 0-5.0 Vdc (scaled 0-50 ppm) NO_x 0-0.5 Vdc (scaled 0-50 ppm)
O2 Paramagnetic Analyzer - Beckman Model 755R	
Response Time	2 Sec
Zero Drift	$\pm$ 1% of full scale
Span Drift	$\pm$ 1% of full scale
Linearity	$\pm$ 1% of full scale
Accuracy	Derived from the calibration O2 $\pm$ 1% gas was used.
Output	0-1.0 Vdc (scaled 0-25%)
CO/CO2 Infrared Analyzers - Beckman Model 880	
Response Time	2 sec
Zero Drift	$\pm$ 1% of full scale
Span Drift	$\pm$ 1% of full scale
Linearity	$\pm$ 1% of full scale
Accuracy	Derived from the calibration CO $\pm$ 1% gas was used.
Output	0-1.0 Vdc (scaled 0-100 ppm CO) 0-1.0 Vdc (scaled 0-20 % CO_2)

Table 3.1 - Continued

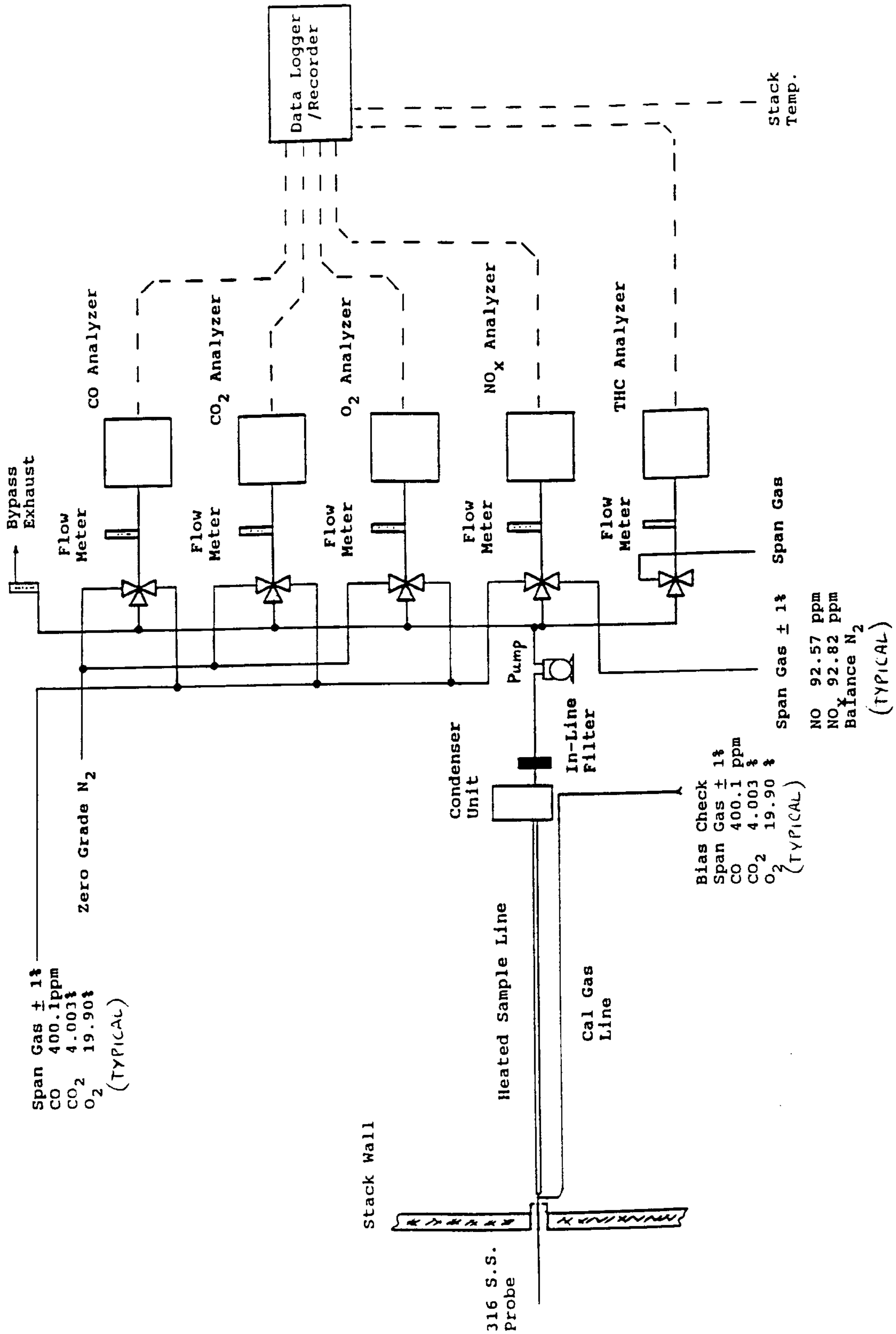
VOC Heated Hydrocarbon Analyzer - J.U.M. Engineering Model VE-7 FID Analyzer			
Response Time	0-95% in less than 1.2 Seconds		
Zero Drift	$\pm$ 1% of Full Scale in 24 Hrs		
Span Drift	$\pm$ 1% of Full scale in 24 Hrs		
Linearity	$\pm$ 1% of Full Scale		
Accuracy	Derived from the Calibration Gas $\pm$ 1% gas was used		
Sensitivity	1 ppb		
Range Change Consistency	Less than 1% Full Scale		
Oxygen Synergism	Less than 2%		
Output	0-10.0 Vdc Scaled:		
	R_1	0-10	ppm as C_3
	R_2	0-100	ppm as C_3
	R_3	0-1,000	ppm as C_3
	R_4	0-10,000	ppm as C_3
	R_5	0-100,000	ppm as C_3
Sample Flow Rate	3 Liters/Minute		

Table 3.2
Calibration Gases

Gas Composition	Use	Cylinder Ser. / No.	Certified Accuracy	Analysis Date
Nitrogen	Zero Gas	AAL / 4542	Zero Grade	N/A
11.0% O_2 50.0 ppmv CO 11.0% CO_2 Bal N_2	Span Gas	1L / 2572	± 1% ± 1% ± 1%	04/08/93
19.0% O_2 75.0 ppm CO 18% CO_2 Bal N_2	Span Gas	ALMO / 04292	± 1%	04/29/93
10.36 ppm NO 10.39 ppm NO_X Bal N_2	Span Gas	ALM / 010841	± 1%*	12/02/93 exp 12/95
22.90 ppm NO 23.46 ppm NO_X Bal N_2	Span Gas	ALM / 034155	± 1%*	10/06/93 exp 10/95
43.83 ppm NO 44.17 ppm NO_X Bal N_2	Span Gas	ALM / 027046	± 1%*	12/23/93 exp 12/95
2.0% CO	Span Gas	ALM / 008830	± 1%*	09/17/93
4.0 CO	Span Gas	ALM / 033923	± 1%*	09/16/93

* EPA Protocol 1 gas.

Figure 3.3
Continuous Monitoring Train - CARB Method 100



hydrocarbons, the instrument was used on a 0-50 ppmv range and standardized with 20 and 40 ppmv propane calibration gases. Each test run was about 50 minutes long.

In order to determine the methane concentration of the stack gas for correcting the total hydrocarbon monitoring data and as a back-up total hydrocarbon analysis, an integrated sample of the flue gas was collected for about 40 minutes concurrently with each monitoring run by using EPA Method 25 modified to eliminate the condensate trap. The sampling train is shown in Figure 3.4 and consisted of a stainless steel sampling probe connected through a flow control device (micro orifice disc meter) to an evacuated 12-liter stainless steel cylinder. The orifice meter reading and the cylinder gage vacuum were recorded at 10-minute intervals during the sampling period on field data sheets (see Appendix B).

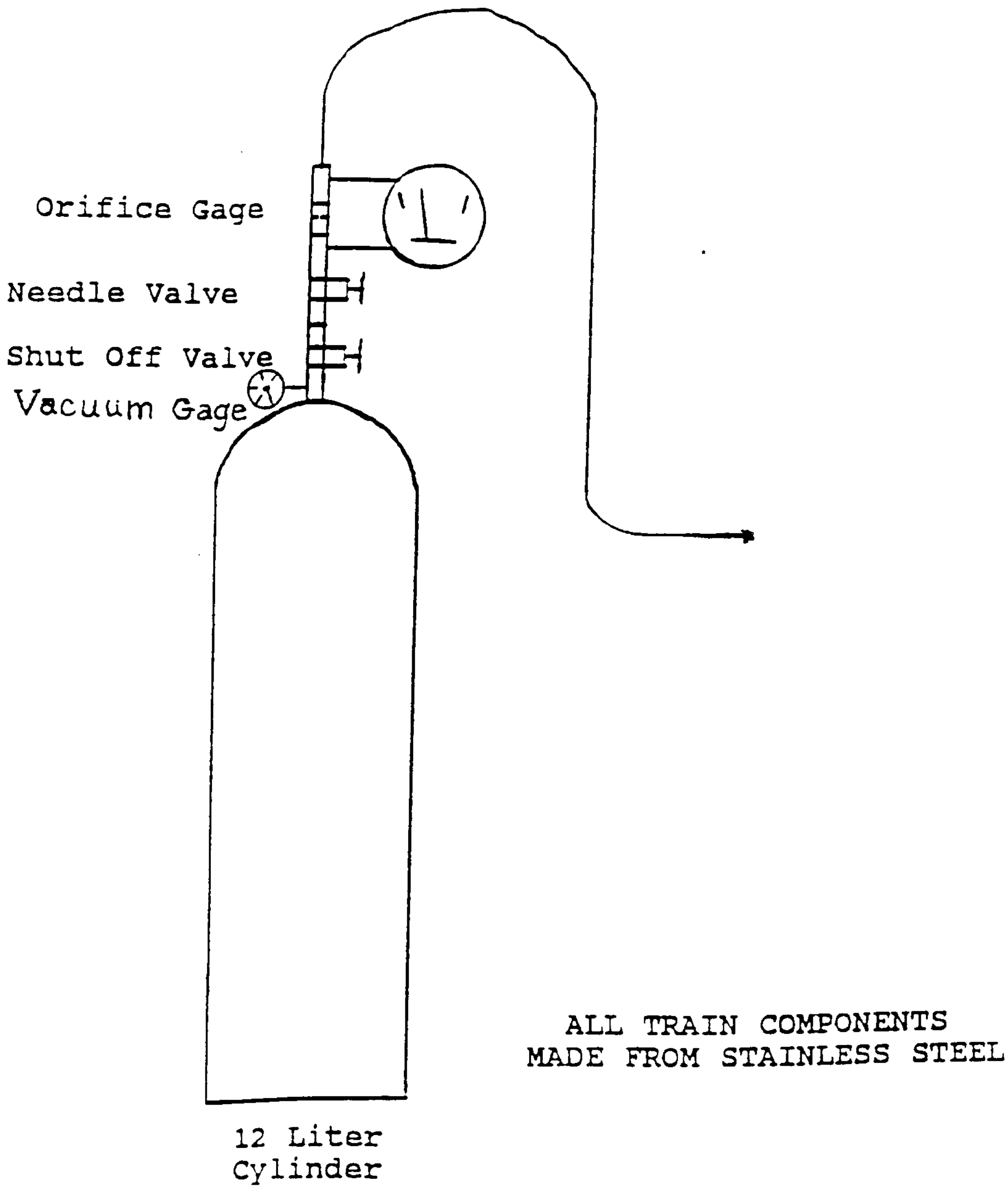
The integrated samples were analyzed for carbon monoxide (CO), methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), and nonmethane hydrocarbons (as C_1) by Truesdail Laboratories, in Tustin, CA according to EPA Method 25. A sample submittal/chain of custody sheet was completed and is included in Appendix B along with the field data and calculation sheets. The analytical procedures performed at Truesdail are detailed in Appendix C along with the laboratory report.

Emission factors for the gases were calculated based on the natural gas usage. A mass balance calculation was performed on the entire power plant. The natural gas usage of all turbines is routed through a gas meter. The gas usage was monitored for first test day and related to the number of turbines operating and the kilowatt load for each.

Sulfur Dioxide

Sulfur dioxide emissions were expected to be very low. Since the source of sulfur is the odorant in the natural gas, the sulfur dioxide emissions were reported in pounds per therm (100 CF of natural gas) by using the sulfur content of the fuel (from the gas supplier).

Figure 3.4
VOC Sampling Train



NOTE: Samples usually collected in duplicate or triplicate concurrentl

CHAPTER 4

RESULTS

Calculations were made from the field data sheets and lab analyses to determine sample volume, molecular weight, velocities, flow rates, component concentrations, and micron cut-off size for the tests.

PM10

Analyses of PM10 emissions for each test run on the turbine included determinations for total solid particulate matter (PM). Condensables were not included in the PM10 results. Although some weight was recorded for each PM10 fraction, 1 milligram was chosen as a level of significance in order to account for fluctuations in the balance weights and for minute amounts of grease contamination from the threads of the PM10 sampling head. Results of the tests are summarized in Table 4.1. No significant PM10 or particulate matter was detected.

Gases

The nitrogen oxide and carbon monoxide emissions were 3.1 and 3.5 pounds per hour, respectively. The emission factors were reported as pounds per therm (100 CF) as indicated on the natural gas meter supplying the power plant. The gas meter had two indicators: one mechanical and one digital. The larger volume reading (digital) was assumed to be the corrected reading and this value was used for all of the emission factors calculations. However, this reading appears to have some unknown multiplier because the therm usage is too low for the known consumption of the gas turbines. For the purposes of calculating any periodic emissions, the emission factors should be used against the digital reading as indicated at the gas meter. Results are reported in Table 4.1.

The continuous monitoring for total hydrocarbons was unexpectedly variable and high (10 to 35 ppmv as C_3) and indicated that the sample line, although heated, was contaminated from previous testing which involved very heavy organics. As a back-up, the integrated sample cylinders that were sampled concurrently and analyzed for methane were also analyzed for total nonmethane hydrocarbons and the resulting average value (5 ppmv) was used to calculate the VOC emission factor. Results are reported in Table 4.2.

The sulfur dioxide emission factor was calculated from information supplied by PG&E in San Francisco, CA which supplies the natural gas to the base. The sulfur dioxide emission factor used by PG&E is 0.001 pounds per million BTU which

Table 4.1
Turbine Number 2 Exhaust - PM10 Continuous Emission Monitoring

Description	Run #1	Run #2	Run #3	Average
Sampling Date	12/03/93	12/03/93	12/03/93	
Sample Number	OAFB-1	OAFB-2	OAFB-3	
Turbine Load, KW	570	570	558	
Waste Heat Damper, %	75	75	75	
Gas Usage, therms/hr	12.4*	12.4*	12.2*	
<u>Flue Gas</u>				
Temperature, °F	450	457	460	
Velocity, ft/sec	117.4	117.1	115.8	
Flow Rate, ACFM	22,120	22,060	21,820	
Flow Rate, DSCFM	12,300	12,200	12,030	
Moisture, % v/v	4.7	4.5	4.5	
<u>PM10</u>				
Sample Start	07:19	10:30	13:54	
Sample Stop	09:22	12:29	15:51	
Sampling Time, min	116.1	115.2	113.7	
Sample volume, DSCF	90.1	90.3	89.1	
Cutoff, microns	10.0	10.0	10.0	
Collection, g	<0.001	<0.001	<0.001	<0.0002
Concentration, g/DSCF	<0.0002	<0.0002	<0.0002	<0.02
Emissions, lbs/hr	<0.02	<0.02	<0.02	<0.002
Factor, lbs/therm	<0.002*	<0.002*	<0.002*	
<u>Total PM</u>				
Collection, g	<0.001	<0.001	<0.001	
Concentration, g/DSCF	<0.0004	<0.0004	<0.0004	<0.0004
Emissions, lbs/hr	<0.04	<0.04	<0.04	<0.04

Table 4.1 - Continued

Description	Run #1	Run #2	Run #3	Average
<u>Continuous Monitoring - Gases</u>				
Sample Start	09:56	11:51	13:46	
Sample Stop	10:56	12:51	14:46	
Concentration, % v/v				
Carbon Dioxide	2.1	2.2	2.2	2.2
Oxygen	17.6	17.5	17.5	17.5
Concentration, ppmv				
Nitrogen Oxides	34	36	37	36
Carbon Monoxide	66	66	66	66
Emissions, lbs/hr				
Nitrogen Oxides	3.0	3.1	3.1	3.1
Carbon Monoxide	3.5	3.5	3.5	3.5
Factor, lbs/therm				
Nitrogen Oxides	0.24*	0.25*	0.25*	0.25*
Carbon Monoxide	0.28*	0.28*	0.29*	0.28*

* Therms as indicated on digital readout of gas meter - appears to have some unknown multiplier.

Table 4.2
Turbine Number 2 Exhaust - Hydrocarbon Emissions

Description	Run #1	Run #2	Run #3	Average
Sampling Date	01/12/94	01/12/94	01/12/94	
Turbine Load, KW	550	550	550	
Waste Heat Damper, %	75	75	75	
Gas Usage, therms/hr	12.0*	12.0*	12.0*	
Flue Gas				
Temperature, °F	441	444	445	
Velocity, ft/sec	103.2	103.2	103.2	
Flow Rate, ACFM	19,450	19,450	19,450	
Flow Rate, DSCFM	10,930	10,930	10,930	
Moisture, % v/v	4.6**	4.6**	4.6**	
Hydrocarbon Samples				
Sample Start	10:56	12:18	13:38	
Sample Stop	11:36	12:58	14:18	
Sampling Time, min	40	40	40	
Concentration, % v/v				18.1
Oxygen (O_2)	17.9	18.2	18.1	
Concentration, ppmv C_1				18,630
Carbon Dioxide (CO_2)	18,610	18,590	18,700	58
Carbon Monoxide (CO)	60	58	57	6
Methane (CH_4)	7	6	6	5
Total HC (w/o CH_4)	<4	11	<4	
Emission Rate, lbs/hr C_1				0.1
Total HC (w/o CH_4)	<0.04	0.22	<0.04	
Emissions Factor, lbs/therm				
Total HC (w/o CH_4)	<0.003*	0.018*	<0.003*	

* Therms as indicated on digital readout of gas meter - appears to have some unknown multiplier.
* From PM10 testing - 12/3/93.

is equivalent to a concentration of 6 ppmv in the natural gas as hydrogen sulfide (H_2S). Results are reported in Table 4.3.

Table 4.3
Turbine Number 2 Exhaust - Sulfur Dioxide Emission Factor

Sulfur Dioxide Emission Factor, lbs/therm	0.0001*

* Based on standard emission factor used by gas supplier (PG&E).

CHAPTER 5

QUALITY ASSURANCE/QUALITY CONTROL

Source tests are performed to determine the types and amounts of pollutants emitted by a source. Information from this source test program may be used for obtaining permits, evaluating control equipment performance, updating emission inventories, and determining compliance with present and future emission regulations. For these purposes, reliable data are required. PES provides this reliability by using the following work practices:

USE OF STANDARD TEST PROCEDURES

CARB Methods 1 and 2 were utilized to measure flow rates. EPA Method 201A was used to determine the PM10 emission rate, and CARB Method 100 was used to determine the continuous emission rates for the gases. A procedure must be thoroughly studied under various conditions in order to be designated as a state or federal Method. Results of many executions of the procedure are compared to demonstrate accuracy and repeatability before adoption of the procedure as a source testing method.

USE OF TRAINED TEST PERSONNEL

Because of the complexity of typical source testing methods, testers should be trained and experienced with the test procedures in order to assure reliable results. PES personnel have had professional training and routinely conduct source tests.

KNOWLEDGE OF SOURCE'S OPERATION

The source testing team should have sufficient knowledge of the process to be tested in order to properly document the process parameters during the tests. Without documentation of the process parameters used, results are much less meaningful. PES has previously tested boilers and combustion sources and is familiar with the processes and equipment.

EQUIPMENT MAINTENANCE AND CALIBRATION

Use of properly maintained and calibrated test equipment is essential for minimizing systematic errors in results. All sampling devices were constructed, maintained, and calibrated as suggested in EPA documents APTD-0576, and APTD-0581 (These are commonly accepted construction and maintenance manuals for source testing equipment). The dry gas meters were calibrated with a transfer gas meter with NBS traceability. These calibrations are included in Appendix D along with those for the nozzles, thermocouples, digital potentiometers, and Pitot tubes.

Quality control procedures used for continuous monitoring included the use of non-reactive 316 stainless steel or Teflon tubing and fittings throughout the system. A refrigeration unit was used with the pump down stream of the conditioned sample gas. All instrumentation was continuously monitored and checked between load conditions to insure data reliability during all sample runs. Bias checks were made with a calibration gas blend to confirm they met the tolerances specified in CARB Method 100.

All calibration gases were ± 1 per cent accuracy and provided by Scott Specialty Gases in San Bernardino, California. Copies of the calibration gas certifications are provided in Appendix D.

THOROUGH RECORD KEEPING

All data relating to the operation of the sampling train must be immediately recorded to ensure that it is not lost or misinterpreted. PES accomplishes this thorough record keeping by use of the field data sheets shown in Appendix B. The PES test team is familiar with these sheets and the information required to complete them. Any unusual occurrences in the process operation, unusual test instrument readings, or any other items that could affect the test results was also noted.

USE OF THOROUGHLY CLEANED GLASSWARE

All glassware and probe lines were cleaned prior to the tests with hot tap water and then with 40 per cent nitric acid solution. The trains were then cleaned with 0.1 Normal sodium hydroxide solution, laboratory grade distilled water, air dried, and sealed until the tests.

USE OF STANDARDIZED DATA REDUCTION TECHNIQUES

Data reduction was accomplished by the use of step by step calculation sheets. The calculations were systematic and easy to follow. All calculations for the source test are included in Appendix B.

SUBMISSION OF BLANK SAMPLES

Filter and reagent samples from an unused but charged PM10 sampling train carried to the field was analyzed with the other samples to detect any possible contamination of sampling media or problems with lab analyses. No corrections were made to the measured concentrations of the collected samples, but the blank train results were reported on the calculation sheets.

APPENDIX A

EQUIPMENT PERMITS

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
939 ELLIS STREET
SAN FRANCISCO, CALIFORNIA 94109
(415) 771-6000

PERMIT
TO OPERATE

Plant# 232 Page 1 Expires: JUL 1, 1993

This document does not permit the holder to violate any District regulation or other law

Gerald Reid
Onizuka Air Force Base
P O Box 3430
Sunnyvale, CA 94088

ORIGINAL SENT TO:
Onizuka Air Force Base
1080 Lockheed Way
Sunnyvale, CA 94088

S#	DESCRIPTION	[Schedule]	PAID
1	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 1 Emissions at: P1 Stack	[B]	150
2	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 2 Emissions at: P2 Stack	[B]	150
3	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 3 Emissions at: P3 Stack	[B]	150
4	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 4 Emissions at: P4 Stack	[B]	150
5	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 5 Emissions at: P5 Stack	[B]	150
6	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 6 Emissions at: P6 Stack	[B]	150
7	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 7 Emissions at: P7 Stack	[B]	150
8	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 8 Emissions at: P8 Stack	[B]	150
9	Turbine - Cogeneration, 12750K BTU/hr max, Multifuel GAS TURBINE ENGINE WITH WASTE HEAT BOILER NO. 9 Emissions at: P9 Stack	[B]	150

APPENDIX B

FIELD DATA AND CALCULATION SHEETS

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

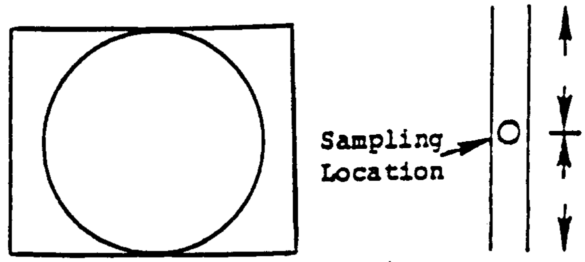
PLANT ONIZUKA AFB
DATE 12-2-93
SAMPLING LOCATION TURBINE #2
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE A) 25"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE B) 1"
STACK I.D., (DISTANCE A - DISTANCE B) 24"
NEAREST UPSTREAM DISTURBANCE 8 Ø
NEAREST DOWNSTREAM DISTURBANCE 2 + Ø
CALCULATOR SHB

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	0.067	24	1.6		
2	0.25	↓	6.0		
3	0.75		18.0		
4	0.93		22.3		

PRELIMINARY VELOCITY TRAVERSE

Plant: ONIZUKA AFB
Date: 12-2-93
Location: TURBINE #2
Stack I.D.: 24"
Barometric Pressure, in. Hg: 30.3
Stack Gauge Pressure, in. H_2O:
Operators: BROWN / KEARNEY
Pitot Tube I.D. Number: S17A
Temperature Readout I.D.: BOX 3A
Pitot Tube Leak Check: OK



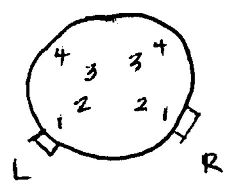
Schematic of Traverse Point Layout

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1-4	2.7	673	
Average			

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
Average			

FIELD DATA

Plant: UNIZUKA AFB
Date: 12-3-93
Sampling Location: TURBINE #2 STACK
Sample Type: PM-10
Run Number: DAFB-1
Operator: BROWN
Ambient Temperature: 55
Barometric Pressure: 30.2
Static Pressure (P_s): -1.1
Filter Number(s): —
Pretest Leak Rate = 0.006 cfm @ 7 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: —
Read and Record all Data Every ~15 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: SS - 5FT - GLASS LINER
Pitot Tube I.D. No.: 5-17A
Nozzle I.D. No. & DIAMETER: ~~0.44~~ 0150 SHB
Assumed Moisture, %: 5.0

Meter Box Number: 3A
Meter $\Delta H_@$: 1.916
C Factor: —
Meter Gamma: 0.99
Heater Box Setting: —
Reference Δp: —
Post Test Leak Rate = 0.006 cfm @ 6 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: —

IMPINGER Box No. 3B ; BLANK Box No: —

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	MIN.
R 4	0	07:19	423.973	2.7	2.0	2.0	450	59	54	4.0	—	45	15.0
3	15	07:34	435.0	2.7	2.1	2.1	452	71	57	4.0	—	50	15.0
2	30	07:49	447.0	2.5	2.1	2.1	454	73	62	4.0	—	45	14.4
(1) 2	44.4	08:03	457.1	2.5	2.2	2.2	453	72	61	4.0	—	43	14.4
FINI	58.8	08:18	468.4	—	—	—	—	—	—	—	—	—	
L 4	58.8	08:24	468.4	2.8	2.2	2.2	438	70	62	4.2	—	43	15.3
3	74.1	08:39	480.5	2.7	2.2	2.2	442	81	65	4.2	—	43	15.0
2	89.1	08:54	492.3	2.2	2.2	2.2	455	86	69	4.4	—	48	13.5
(1) 2	102.6	09:08	503.1	2.2	2.2	2.2	455	86	71	4.5	—	47	13.5
FINI	116.1	09:22	513.852	—	—	—	—	—	—	—	—	—	
				$\sqrt{\Delta P}$=1.59			T_s=450					≤68	
	Θ=116.1		V_M=89.879		ΔH=	2.15		T_M=	69				
GAS	METER	x100											
	07:13		998121	302463									
	09 40		998363	302641									
			242	178	1.45	HRS							

SAMPLE RETRIEVAL DATA

Plant: ONIZUKA AFB
Date: 12-3-93
Sampling Location: TURBINE #2 STACK
Sampling Type (Method): PM-10
Run Number: ~~3B~~ ~~AB~~ OAFB-1
Sample Box Number: 3B
Clean-up Man: BROWN, KEARNEY
Job Number: F028
Comments:

Filter

Filter Number:
Description of Filter: CLEAN

Moisture

Impingers:	#1	#2	#3
Final Volume:	157.0 mL	102.0 mL	16.0 mL
Initial Volume:	100.0 mL	100.0 mL	0.0 mL
Net Volume:	57.0 mL	2.0 mL	16.0 mL
Total H_2O:	57 mL	59 mL	75 mL

Silica Gel

Final Volume:	700.9 g	g	g
Initial Volume:	681.9 g	g	g
Net Volume:	19.0 g	g	g
Total Moisture:	94 g	g	g

Description of Inpinger catch: CLEAR

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-1

1. $Vm(std) = (17.64)(Vm)(Y)\left[\dfrac{P_{bar} + (\Delta H/13.6)}{Tm}\right]$

$Vm(std) = (17.64)(89.879)(0.99)\left[\dfrac{(30.2) + (2.15/13.6)}{(529)}\right]$

Vm(std) = 90.1 dscf.

2. Volume water vapor collected (standard conditions).

V(lo) = 94 condensate from impingers and selica gel.

Vw(std) = (0.04707) V(lo) = (0.04707)(94)

Vw(std) = 4.42 scf.

3. Percent moisture, by volume.

$Bw_s = \dfrac{Vw(std)}{Vw(std) + Vm(std)} = \dfrac{(4.42)}{(4.42) + (90.1)} = 0.047$

Bw_s = 4.7%.

4. Molecular weight, stack gas.

Dry molecular weight.

$Md = 0.440(\%\ CO_2) + 0.320(\%\ O_2) + 0.280(\%\ N_2 + \%\ CO)$

$Md = 0.440\ (2.5) + 0.320(17.5) + 0.280(80)$

Md = 29.1 lb/lb-mole.

$Ms = Md + Bw_s\ (18 - Md) = (29.1) + (0.047)(18 - 29.1)$

Ms = 28.58 lb/lb-mole.

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-1

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.84)(1.59)\left[\sqrt{\frac{(910)}{(30.1)(28.58)}}\right]$$

Vs(avg) = 117.4 ft/sec.

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

Qs = (60)(Vs)(A) = (60)(117.4)(3.14)

Qs = 22118 acfm.

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(22118)(1-0.047)\left[\frac{(30.1)}{(910)}\right]$$

Q(std) = 12299 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1-Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(\quad)(\quad)}{(\quad)(\quad)(\quad)(\quad)(1-\quad)}\right]$$

%I = N/A %

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-1

9. Viscosity of stack gas:

$$\mu_s = 152.418 + 0.2552\ t_s + 3.2355x10^{-5}\ (t_s)^2 + 0.53147\ (\%O_2) - 74.143\ Bw_s$$

$$\mu_s = 152.418 + 0.2552(450) + 3.2355x10^{-5}\ (450)^2 + 0.53147(17.5) - 74.143(0.047)$$

μ_s = 279.6 micropoise.

10. Cyclone flow rate:

$$Q_s = 0.002837\ \mu_s \left(\frac{t_s + 460}{M_w\ P_s}\right)^{0.2949}$$

$$Q_s = 0.002837(279.6) \left(\frac{(450) + 460}{(28.58)(30.1)}\right)^{0.2949}$$

Q_s = 0.81 ft^3/min

11. Orifice pressure head for cyclone flow rate:

$$\Delta H = \left(\frac{Q_s(1-Bw_s)P_s}{t_s + 460}\right)^2 \left(\frac{(t_m + 460)\ M_d\ (1.083)\ \Delta H@}{P_{bar}}\right)$$

$$\Delta H = \left(\frac{(0.81)(1-0.047)(30.1)}{(450) + 460}\right)^2 \left(\frac{(69 + 460)(29.1)(1.083)(1.916)}{(30.2)}\right)$$

ΔH = 0.69 in. H_2O

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-1

Stack viscosity, μ_s, micropoise =	279.6
Absolute stack pressure, P_s, in. Hg =	30.1
Average stack temperature, t_s, °F =	450
Meter temperature, t_m, °F =	69
Method 201A pitot coefficient, C_p =	0.84
Cyclone flow rate, ft³/min, Q_s =	0.81
Method 2 pitot coefficient, C_p =	0.84
Molecular weight of stack gas, wet basis, M_w =	28.58
Nozzle diameter, D_n, in. =	0.150

Nozzle velocity

$$v_n = \frac{3.056\ Q_s}{D_n^2} = \underline{110.0}\ \text{ft/sec}$$

Maximum and minimum velocities:

Calculate R_{min}.

$$R_{min} = 0.2457 + \sqrt{0.3072 - \frac{0.2603\ (\sqrt{Q_s}\ )\ \mu_s}{v_n^{1.5}}} = \underline{0.75}$$

If R_{min} is less than 0.5, or if an imaginary number occurs when calculating R_{min}, use Equation 1 to calculate v_{min}. Otherwise, use Equation 2.

Eq. 1 $\quad v_{min} = v_n\ (0.5) = \underline{\qquad}$ ft/sec

Eq. 2 $\quad v_{min} = v_n\ R_{min} = \underline{82.5}$ ft/sec

Calculate R_{max}.

$$R_{max} = 0.4457 + \sqrt{0.5690 + \frac{0.2603\ (\sqrt{Q_s}\ )\ \mu_s}{v_n^{1.5}}} = \underline{1.24}$$

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-1

If R_{max} is greater than 1.5, use Equation 3 to calculate v_{max}. Otherwise, use Equation 4.

Eq. 3 $v_{max} = v_n (1.5) =$ ______ ft/sec

Eq. 4 $v_{max} = v_n R_{max} =$ 136.4 ft/sec

Maximum and minimum velocity head values:

$$\Delta p_{min} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{min})^2}{(t_s + 460) C_p^2} = 1.25 \text{ in. } H_2O$$

$$\Delta p_{max} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{max})^2}{(t_s + 460) C_p^2} = 3.41 \text{ in. } H_2O$$

Calculate the actual D_{50} of the cyclone for the given conditions as follows:

$$D_{50} = \beta_1 \left(\frac{t_s + 460}{M_w P_s} \right)^{0.2091} x \left(\frac{\mu_s}{Q_s} \right)^{0.7091}$$

where, $\beta_1 = 0.15625$

$$D_{50} = (0.15625) \left(\frac{910}{(28.58)(30.1)} \right)^{0.2091} x \left(\frac{279.6}{0.81} \right)^{0.7091}$$

$D_{50} =$ 9.97 μm

CLIENT: ONIZUKA AFB

Project No. F028

PM 10
TEST #1

PARTICULATE CALCULATIONS

Sampling Location: TURBINE #2 EXHAUST Test Date: 12-03-93

Sample Number: OAFB-1 Sample Volume: 90.1 DSCF

Stack Flow Rate: 12,300 DSCFM

Particulate Catch: (grams)

		PM10	>PM10	
Filter:	Final Weight	0.2084		
	Initial Weight	0.2083		
	Net Weight	0.0001		
ACETONE ~~Impinger:~~	Final Weight	28.6871	29.0835	
	Initial Weight	28.6878	29.0832	
	Net Weight	-0.0007	0.0003	
Extract:	Final Weight			
	Initial Weight			
	Net Weight			
Total:		<0.0010	<0.0010	

Particulate Concentration:

$$\frac{(<0.001)\text{ grams} \times 15.43\text{ grains/gram}}{(90.1)\text{ DSCF}} = <0.0002 \text{ grains/DSCF}$$

Particulate Emissions:

$$\frac{(<0.0002)\text{ gr/DSCF} \times (12{,}300)\text{ DSCFM} \times 60\text{ min/hr}}{7000\text{ grains/lb}} = <0.02 \text{ lbs/hr}$$

Rule 404 Limitation @ NA SCFM = ________ grains/DSCF

Rule 405 Limitation @ NA lbs/hr = ________ lbs/hr

FIELD DATA

Plant: ONIZUKA AFB
Date: 12-3-93
Sampling Location: TURBINE #2 STACK
Sample Type: PM-10
Run Number: OAFB-2
Operator: BROWN
Ambient Temperature: 72
Barometric Pressure: 30.2
Static Pressure (P_s): -1.2
Filter Number(s):
Pretest Leak Rate = 0.008 cfm @ 5 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: —
Read and Record all Data Every ~15 Minutes

(SEE TEST 1)

Schematic of Traverse Point Layout

Probe Length and Type: SS - 5FT - GLASS LINED
Pitot Tube I.D. No.: S-17A
Nozzle I.D. No. & DIAMETER: 0.150
Assumed Moisture, %: 5.0

Meter Box Number: 3A
Meter $\Delta H_@$: 1.916
C Factor: —
Meter Gamma: 0.99
Heater Box Setting: —
Reference Δp: —
Post Test Leak Rate = 0.012 cfm @ 5 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: —

IMPINGER BOX NO. 3B ; BLANK BOX NO: —

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	MIN
L 4	0	10:30	513.919	2.7	2.2	2.2	442	74	70	4.7	—	49	15.0
3	15.0	10:45	524.3	2.7	2.2	2.2	449	83	74	4.8	—	50	15.0
2	30.0	11:00	536.4	2.2	2.3	2.3	460	91	78	4.8	—	53	13.5
(1) 2	43.5	11:14	547.7	2.2	2.3	2.3	461	93	81	4.9	—	54	13.5
FINI	57.0	11:26	558.8	—	—	—	—	—	—	—	—	—	
R 4	57.0	11:31	558.8	2.8	2.3	2.3	457	95	85	4.9	—	58	15.3
3	72.3	11:46	571.6	2.6	2.3	2.3	461	100	88	5.0	—	59	14.7
2	87.0	12:01	584.3	2.4	2.3	2.3	464	98	90	5.0	—	61	14.1
(1) 2	101.1	12:15	595.7	2.4	2.3	2.3	465	96	89	4.8	—	61	14.1
	115.2	12:29	607.011	—	—	—	—	—	—	—	—	—	
	θ=115.2		V_m=93.092		ΔH=2.3			T_m=87					
				√ΔP=1.59			T_s=457					≤68	
GAS	METER	x100											
	09:40		998 363	302641									
	13:09		998 707	302905									
			344	264	3.48	HRS							

SAMPLE RETRIEVAL DATA

Plant: ONIZUKA AFB
Date: 12-3-93
Sampling Location: TURBINE #2 STACK
Sampling Type (Method): PM-10
Run Number: OAFB-2
Sample Box Number: 3B
Clean-up Man: BROWN, KEARNEY
Job Number: F028
Comments:

Filter

Filter Number:			
Description of Filter:	CLEAN		

Moisture

Impingers:	#1	#2	#3
Final Volume:	156.0 mL	108 mL	3.0 mL
Initial Volume:	100.0 mL	100.0 mL	0.0 mL
Net Volume:	56 mL	8 mL	3 mL
Total H_2O:	56 mL	64 mL	67 mL

Silica Gel

Final Volume:	682.3 g	g	g
Initial Volume:	659.7 g	g	g
Net Volume:	22.6 g	g	g
Total Moisture:	89.6 g	g	g

Description of Inpinger catch: CLEAR

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-2

1. $Vm(std) = (17.64)(Vm)(Y)\left[\dfrac{P_{bar} + (\Delta H/13.6)}{Tm}\right]$

   $Vm(std) = (17.64)(93.092)(0.99)\left[\dfrac{(30.2) + (2.3/13.6)}{(547)}\right]$

   Vm(std) = 90.3 dscf.

2. Volume water vapor collected (standard conditions).

   V(lo) = 89.6 condensate from impingers and selica gel.

   Vw(std) = (0.04707) V(lo) = (0.04707)(89.6)

   Vw(std) = 4.22 scf.

3. Percent moisture, by volume.

   $Bw_s = \dfrac{Vw(std)}{Vw(std) + Vm(std)} = \dfrac{(4.22)}{(4.22) + (90.3)} = 0.045$

   Bw_s = 4.5 % .

4. Molecular weight, stack gas.

   Dry molecular weight.

   $Md = 0.440(\%\ CO_2) + 0.320(\%\ O_2) + 0.280(\%\ N_2 + \%\ CO)$

   $Md = 0.440(2.5) + 0.320(17.5) + 0.280(80)$

   Md = 29.1 lb/lb-mole.

   $Ms = Md + Bw_s(18 - Md) = (29.1) + (0.045)(18 - 29.1)$

   Ms = 28.6 lb/lb-mole.

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-2

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.84)(1.58)\left[\sqrt{\frac{(917)}{(30.1)(28.6)}}\right]$$

Vs(avg) = 117.1 ft/sec.

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

Qs = (60)(Vs)(A) = (60)(117.1)(3.14)

Qs = 22062 acfm.

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(22062)(1-0.045)\left[\frac{(30.1)}{(917)}\right]$$

Q(std) = 12200 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1 - Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(\quad)(\quad)}{(\quad)(\quad)(\quad)(\quad)(1 - \quad)}\right]$$

%I = N/A %

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-2

9. Viscosity of stack gas:

$$\mu_s = 152.418 + 0.2552\ t_s + 3.2355\text{x}10^{-5}\ (t_s)^2 +$$

$$0.53147\ (\%O_2) - 74.143\ Bw_s$$

$$\mu_s = 152.418 + 0.2552(457) + 3.2355\text{x}10^{-5}\ (457)^2 +$$

$$0.53147(17.5) - 74.143(0.045)$$

μ_s = 281.8 micropoise.

10. Cyclone flow rate:

$$Q_s = 0.002837\ \mu_s \left(\frac{t_s + 460}{M_w\ P_s}\right)^{0.2949}$$

$$Q_s = 0.002837(281.8)\left(\frac{(457) + 460}{(28.6)(30.1)}\right)^{0.2949}$$

Q_s = 0.81 ft^3/min

11. Orifice pressure head for cyclone flow rate:

$$\Delta H = \left(\frac{Q_s(1-Bw_s)P_s}{t_s + 460}\right)^2 \left(\frac{(t_m + 460)\ M_d\ (1.083)\ \Delta H@}{P_{bar}}\right)$$

$$\Delta H = \left(\frac{(0.81)(1-0.045)(30.1)}{(457) + 460}\right)^2 \left(\frac{(87 + 460)(29.1)(1.083)(1.916)}{(30.2)}\right)$$

ΔH = 0.71 in. H_2O

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-2

Stack viscosity, μ_s, micropoise = 281.8
Absolute stack pressure, P_s, in. Hg = 30.1
Average stack temperature, t_s, °F = 457
Meter temperature, t_m, °F = 87
Method 201A pitot coefficient, C_p = 0.84
Cyclone flow rate, ft^3/min, Q_s = 0.81
Method 2 pitot coefficient, C_p = 0.84
Molecular weight of stack gas, wet basis, M_w = 28.6
Nozzle diameter, D_n, in. = 0.150

Nozzle velocity

$$v_n = \frac{3.056\ Q_s}{D_n^2} = \underline{110.0}\ \text{ft/sec}$$

Maximum and minimum velocities:

Calculate R_{min}.

$$R_{min} = 0.2457 + \sqrt{0.3072 - \frac{0.2603\ (\sqrt{Q_s}\ )\ \mu_s}{v_n^{1.5}}} = \underline{0.75}$$

If R_{min} is less than 0.5, or if an imaginary number occurs when calculating R_{min}, use Equation 1 to calculate v_{min}. Otherwise, use Equation 2.

Eq. 1 $\quad v_{min} = v_n\ (0.5) =$ ______ ft/sec

Eq. 2 $\quad v_{min} = v_n\ R_{min} = \underline{82.5}$ ft/sec

Calculate R_{max}.

$$R_{max} = 0.4457 + \sqrt{0.5690 + \frac{0.2603\ (\sqrt{Q_s}\ )\ \mu_s}{v_n^{1.5}}} = \underline{1.24}$$

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-2

If R_{max} is greater than 1.5, use Equation 3 to calculate v_{max}. Otherwise, use Equation 4.

Eq. 3 $\quad v_{max} = v_n (1.5) = \_\_\_\_\_$ ft/sec

Eq. 4 $\quad v_{max} = v_n R_{max} = \underline{136.4}$ ft/sec

Maximum and minimum velocity head values:

$$\Delta p_{min} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{min})^2}{(t_s + 460)\ C_p^2} = \underline{1.24} \text{ in. } H_2O$$

$$\Delta p_{max} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{max})^2}{(t_s + 460)\ C_p^2} = \underline{3.39} \text{ in. } H_2O$$

Calculate the actual D_{50} of the cyclone for the given conditions as follows:

$$D_{50} = \beta_1 \left(\frac{t_s + 460}{M_w\ P_s} \right)^{0.2091} \times \left(\frac{\mu_s}{Q_s} \right)^{0.7091}$$

where, $\beta_1 = 0.15625$

$$D_{50} = (0.15625) \left(\frac{917}{(28.6)(30.1)} \right)^{0.2091} \times \left(\frac{281.8}{0.81} \right)^{0.7091}$$

$D_{50} = \underline{10.04}\ \mu m$

CLIENT: ONIZUKA AFB

Project No. F028

PARTICULATE CALCULATIONS PM10 TEST #2

Sampling Location: TURBINE #2 EXHAUST Test Date: 12-03-94

Sample Number: OAFB-2 Sample Volume: 90.3 DSCF

Stack Flow Rate: 12,200 DSCFM

Particulate Catch: (grams)

		PM10	>PM10	
Filter:	Final Weight	0.2066		
	Initial Weight	0.2072		
	Net Weight	-0.0006		
ACETONE ~~Impinger:~~	Final Weight	28.6117	28.3456	
	Initial Weight	28.6117	28.3443	
	Net Weight	0.0000	0.0013	
Extract:	Final Weight			
	Initial Weight			
	Net Weight			
Total:		<0.0010	0.0013	

Particulate Concentration:

$$\frac{(<0.0010)\text{ grams} \times 15.43\text{ grains/gram}}{(90.3)\text{ DSCF}} = <0.0002\text{ grains/DSCF}$$

Particulate Emissions:

$$\frac{(<0.0002)\text{ gr/DSCF} \times (12,200)\text{ DSCFM} \times 60\text{ min/hr}}{7000\text{ grains/lb}} = <0.02\text{ lbs/hr}$$

Rule 404 Limitation @ NA SCFM = ________ grains/DSCF

Rule 405 Limitation @ NA lbs/hr = ________ lbs/hr

FIELD DATA

Plant: ONIZUKA AFB
Date: 12-3-93
Sampling Location: TURBINE #2 STACK
Sample Type: PM-10
Run Number: OAFB-3
Operator: BROWN
Ambient Temperature: 75
Barometric Pressure: 30.2
Static Pressure (P_s): -1.25
Filter Number(s): –
Pretest Leak Rate = 0.007 cfm @ 5 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: –
Read and Record all Data Every ~15 Minutes

(SEE TEST #1)

Schematic of Traverse Point Layout

Probe Length and Type: SS - 5FT - GLASS LINED
Pitot Tube I.D. No.: S-17A
Nozzle I.D. No. & DIAMETER: 0.150
Assumed Moisture, %: 5.0

Meter Box Number: 3A
Meter $\Delta H_@$: 1.916
C Factor: –
Meter Gamma: 0.99
Heater Box Setting: –
Reference Δp: –
Post Test Leak Rate = 0.010 cfm @ 5 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: –

IMPINGER BOX NO. 3B ; BLANK BOX NO. –

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	MIN.
R 4	0	13:54	607.078	2.8	2.2	2.2	460	80	80	4.2	–	43	15.3
3	15.3	14:09	619.1	2.5	2.2	2.2	463	89	81	4.3	–	52	14.4
2	29.7	14:23	630.8	2.4	2.2	2.2	465	92	82	4.4	–	54	14.1
(1) 2	43.8	14:37	642.1	2.4	2.2	2.2	467	91	82	4.4	–	55	14.1
FINI	57.9	14:51	653.4	–	–	–	–	–	–	–	–	–	
L 4	57.9	14:55	653.4	2.6	2.2	2.2	448	83	79	4.5	–	55	14.7
3	72.6	15:10	665.2	2.6	2.2	2.2	449	82	77	4.5	–	57	14.7
2	87.3	15:25	677.0	2.1	2.2	2.2	464	81	75	4.6	–	60	13.2
(1) 2	100.5	15:38	687.6	2.1	2.2	2.2	463	83	75	4.8	–	63	13.2
FINI	113.7	15:51	698.155	–	–	–	–	–	–	–	–	–	
	θ=113.7		V_m=91.077	Δ 1.56	ΔH=	2.2		T_m=	82				
				$\sqrt{\Delta P}$=2.44			T_s=460					≤68	
GAS	METER	X100											
	13:09		998707	302905									
	16:53		999030	303144									
			323	239	2.74	HRS							

SAMPLE RETRIEVAL DATA

Plant: ONIZUKA AFB
Date: 12-3-93
Sampling Location: TURBINE #2 STACK
Sampling Type (Method): PM-10
Run Number: OAFB-3
Sample Box Number: 3B
Clean-up Man: BROWN, KEARNEY
Job Number: F028
Comments:

Filter

Filter Number:
Description of Filter:

Moisture

Impingers:			
Final Volume:	154.0 mL	106.0 mL	~~1~~3.0 mL
Initial Volume:	100.0 mL	100.0 mL	0.0 mL
Net Volume:	54 mL	6.0 mL	3.0 mL
Total H_2O:	54 mL	60 mL	63 mL

Silica Gel

Final Volume:	715.2 g	g	g
Initial Volume:	690.1 g	g	g
Net Volume:	25.1 g	g	g
Total Moisture:	88.1 g	g	g

Description of Inpinger catch:

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-3

1. $Vm(std) = (17.64)(Vm)(Y)\left[\frac{P_{bar} + (\Delta H/13.6)}{Tm}\right]$

$Vm(std) = (17.64)(91.077)(0.99)\left[\frac{(30.2) + (2.2/13.6)}{(542)}\right]$

Vm(std) = 89.1 dscf.

2. Volume water vapor collected (standard conditions).

V(lo) = 88.1 condensate from impingers and selica gel.

Vw(std) = (0.04707) V(lo) = (0.04707)(88.1)

Vw(std) = 4.15 scf.

3. Percent moisture, by volume.

$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(4.15)}{(4.15) + (89.1)} = 0.045$

Bw_s = 4.5% .

4. Molecular weight, stack gas.

Dry molecular weight.

$Md = 0.440(\%\ CO_2) + 0.320(\%\ O_2) + 0.280(\%\ N_2 + \%\ CO)$

Md = 0.440 (2.5) + 0.320(17.5) + 0.280(80)

Md = 29.1 lb/lb-mole.

$Ms = Md + Bw_s\ (18 - Md) = (29.1) + (0.045)(18 - 29.1)$

Ms = 28.6 lb/lb-mole.

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-3

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.84)(1.56)\left[\sqrt{\frac{(920)}{(30.1)(28.6)}}\right]$$

Vs(avg) = 115.8 ft/sec.

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

Qs = (60)(Vs)(A) = (60)(115.8)(3.14)

Qs = 21817 acfm.

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(21817)(1-0.045)\left[\frac{(30.1)}{(920)}\right]$$

Q(std) = 12025 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1-Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(\quad)(\quad)}{(\quad)(\quad)(\quad)(\quad)(1-\quad)}\right]$$

%I = N/A %

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-3

9. Viscosity of stack gas:

$$\mu_s = 152.418 + 0.2552\ t_s + 3.2355\text{x}10^{-5}\ (t_s)^2 + 0.53147\ (\%O_2) - 74.143\ Bw_s$$

$$\mu_s = 152.418 + 0.2552(460) + 3.2355\text{x}10^{-5}\ (460)^2 + 0.53147(17.5) - 74.143(0.045)$$

μ_s = 282.6 micropoise.

10. Cyclone flow rate:

$$Q_s = 0.002837\ \mu_s \left(\frac{t_s + 460}{M_w\ P_s}\right)^{0.2949}$$

$$Q_s = 0.002837(282.6) \left(\frac{(460) + 460}{(28.6)(30.1)}\right)^{0.2949}$$

Q_s = 0.82 ft^3/min

11. Orifice pressure head for cyclone flow rate:

$$\Delta H = \left(\frac{Q_s(1-Bw_s)P_s}{t_s + 460}\right)^2 \left(\frac{(t_m + 460)\ M_d\ (1.083)\ \Delta H@}{P_{bar}}\right)$$

$$\Delta H = \left(\frac{(0.82)(1-0.045)(30.1)}{(460) + 460}\right)^2 \left(\frac{(82 + 460)(29.1)(1.083)(1.916)}{(30.2)}\right)$$

ΔH = 0.71 in. H_2O

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-3

Stack viscosity, μ_s, micropoise =	282.6
Absolute stack pressure, P_s, in. Hg =	30.1
Average stack temperature, t_s, °F =	460
Meter temperature, t_m, °F =	82
Method 201A pitot coefficient, C_p =	0.84
Cyclone flow rate, ft³/min, Q_s =	0.82
Method 2 pitot coefficient, C_p' =	0.84
Molecular weight of stack gas, wet basis, M_w =	28.6
Nozzle diameter, D_n, in. =	0.150

Nozzle velocity

$$v_n = \frac{3.056\ Q_s}{D_n^2} = \underline{111.4}\ \text{ft/sec}$$

Maximum and minimum velocities:

Calculate R_{min}.

$$R_{min} = 0.2457 + \sqrt{0.3072 - \frac{0.2603\ (\sqrt{Q_s})\ \mu_s}{v_n^{1.5}}} = \underline{0.75}$$

If R_{min} is less than 0.5, or if an imaginary number occurs when calculating R_{min}, use Equation 1 to calculate v_{min}. Otherwise, use Equation 2.

Eq. 1 $\quad v_{min} = v_n\ (0.5) = \_\_\_\_\_\_$ ft/sec

Eq. 2 $\quad v_{min} = v_n\ R_{min} = \underline{83.6}$ ft/sec

Calculate R_{max}.

$$R_{max} = 0.4457 + \sqrt{0.5690 + \frac{0.2603\ (\sqrt{Q_s})\ \mu_s}{v_n^{1.5}}} = \underline{1.24}$$

Plant: ONIZUKA AFB

Date: 12-3-93

Source/Sample Number: OAFB-3

If R_{max} is greater than 1.5, use Equation 3 to calculate v_{max}. Otherwise, use Equation 4.

Eq. 3 $v_{max} = v_n (1.5) =$ ______ ft/sec

Eq. 4 $v_{max} = v_n R_{max} =$ 138.1 ft/sec

Maximum and minimum velocity head values:

$$\Delta p_{min} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{min})^2}{(t_s + 460) C_p^2} = 1.27 \text{ in. } H_2O$$

$$\Delta p_{max} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{max})^2}{(t_s + 460) C_p^2} = 3.46 \text{ in. } H_2O$$

Calculate the actual D_{50} of the cyclone for the given conditions as follows:

$$D_{50} = \beta_1 \left(\frac{t_s + 460}{M_w P_s} \right)^{0.2091} \times \left(\frac{\mu_s}{Q_s} \right)^{0.7091}$$

where, $\beta_1 = 0.15625$

$$D_{50} = (0.15625) \left(\frac{920}{(28.6)(30.1)} \right)^{0.2091} \times \left(\frac{282.6}{0.32} \right)^{0.7091}$$

D_{50} = 9.98 µm

CLIENT: ONIZUKA AFB

Project No. F028

PARTICULATE CALCULATIONS PM10 TEST #3

Sampling Location: TURBINE #2 EXHAUST Test Date: 12-03-94

Sample Number: OAFB-3 Sample Volume: 89.1 DSCF

Stack Flow Rate: 12,030 DSCFM

Particulate Catch: (grams)

		PM10	> PM10	
Filter:	Final Weight	0.2056		
	Initial Weight	0.2065		
	Net Weight	-0.0009		
Impinger:	Final Weight	28.6882	28.1727	
	Initial Weight	28.6882	28.1721	
	Net Weight	0.0000	0.0006	
Extract:	Final Weight			
	Initial Weight			
	Net Weight			
Total:		<0.0010	0.0006	

Particulate Concentration:

$$\frac{(<0.0010)\text{ grams} \times 15.43\text{ grains/gram}}{(89.1)\text{ DSCF}} = <0.0002 \text{ grains/DSCF}$$

Particulate Emissions:

$$\frac{(<0.0002)\text{ gr/DSCF} \times (12{,}030)\text{ DSCFM} \times 60\text{ min/hr}}{7000\text{ grains/lb}} = <0.02 \text{ lbs/hr}$$

Rule 404 Limitation @ NA SCFM = ________ grains/DSCF

Rule 405 Limitation @ NA lbs/hr = ________ lbs/hr

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
F028	1	1

Client: ONIZUKA AFB

Location: TURBINE #2

Prepared By	Date	Checked By	Date	Sheet Title
[signature]	12/16/93	SHB	1/28/94	PM - 10

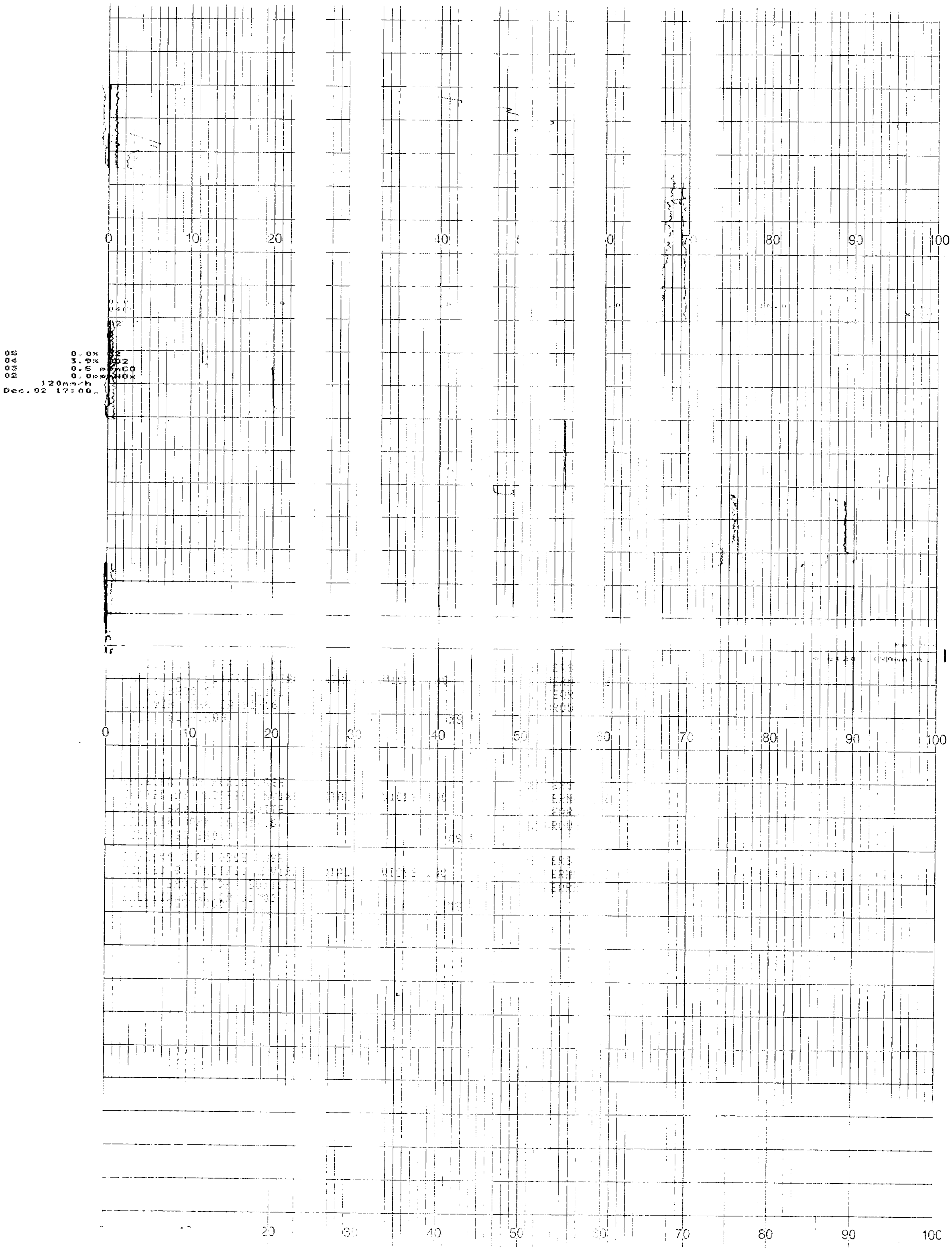
BEAKER	POST WEIGHT g	PRE WEIGHT g	NET g
1A	29.0835	29.0832	0.0003
2A	28.3456	28.3443	0.0013
3A	28.1727	28.1721	0.0006
1B	28.6871	28.6878	-0.0007
2B	28.6117	28.6117	0.0000
3B	28.6882	28.6882	0.0000

NOTE: NO SIGNIFICANT CATCHES

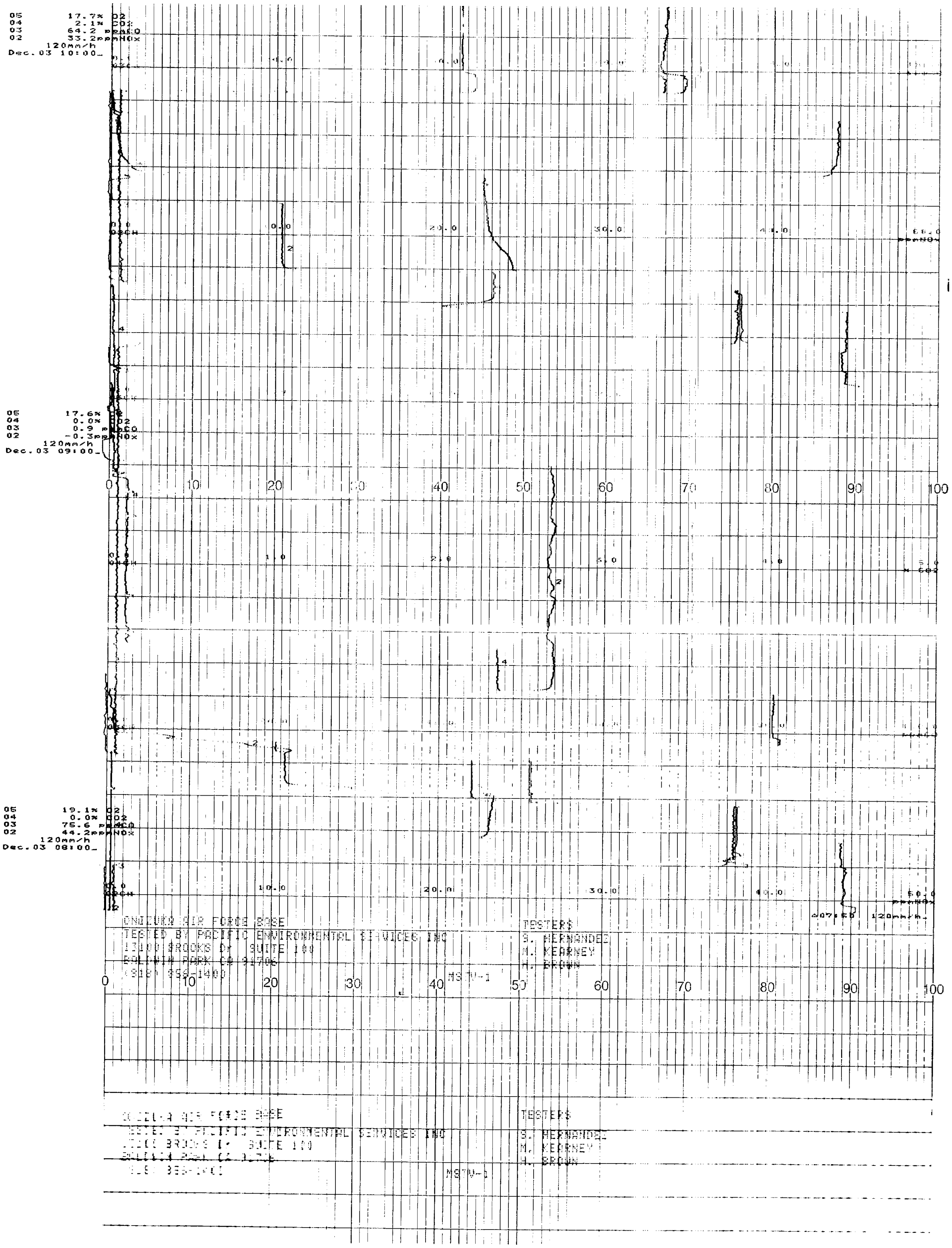
I.E. < 1 mg PM 10
< 1 mg > PM10

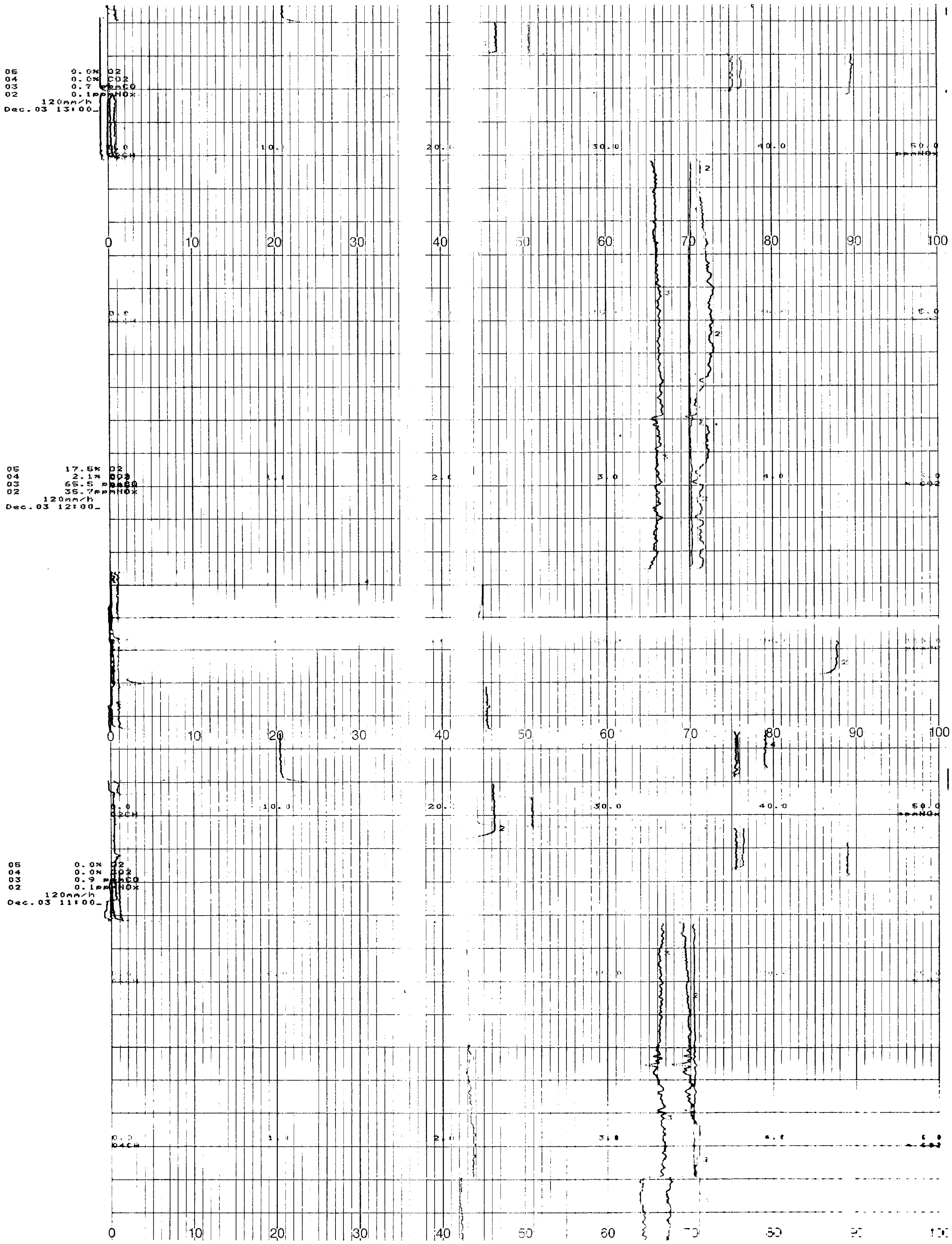
FILTERS:

1	0.2084	0.2083	0.0001
2	0.2066	0.2072	-0.0006
3	0.2056	0.2065	-0.0009

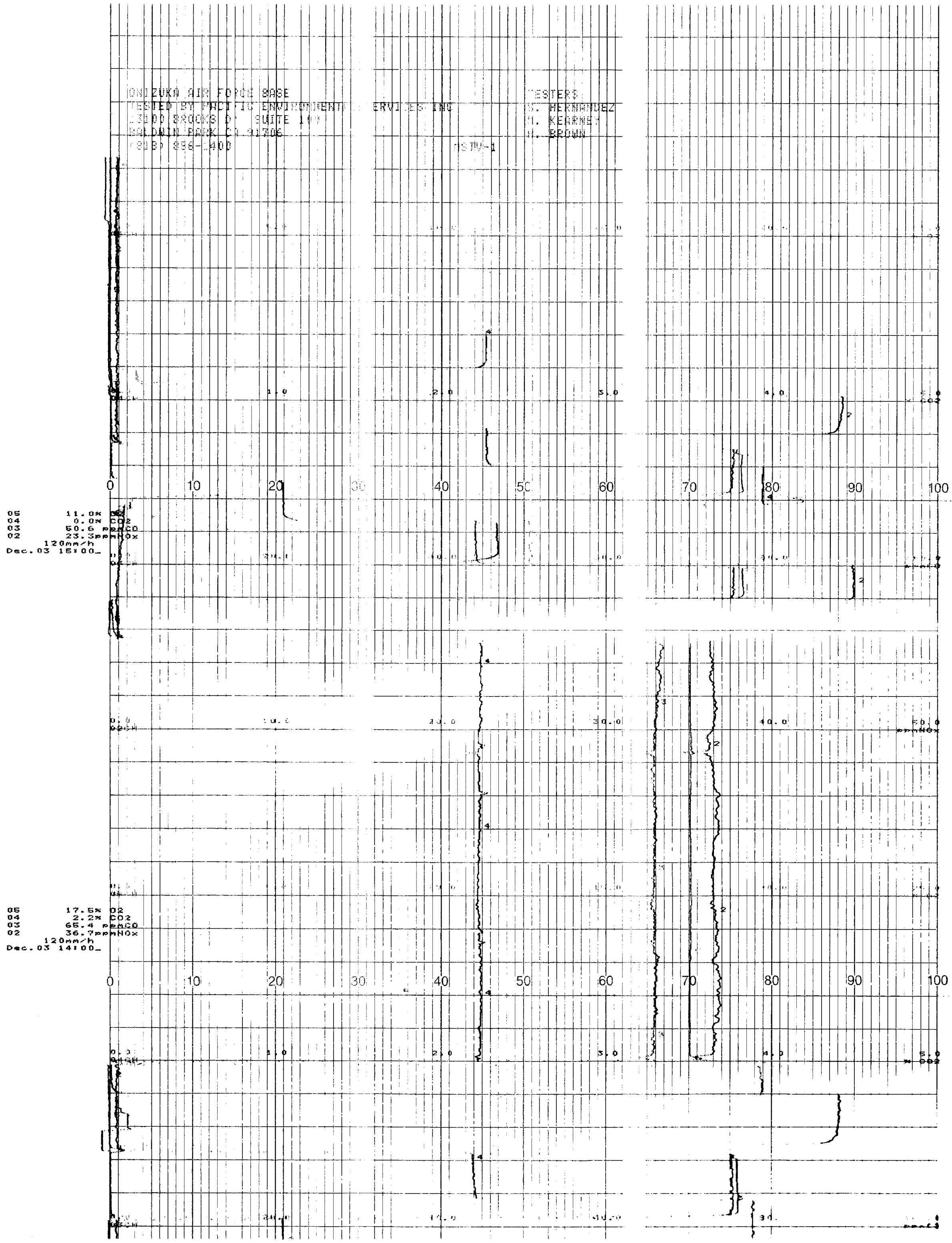


05 0.0% O2
04 3.9% CO2
03 0.5 ppm CO
02 0.0ppm NOx
120mm/h
Dec.02 17:00
0 10 20 30 40 50 60 70 80 90 100


05 17.7% O2
04 2.1% CO2
03 64.2 ppmCO
02 33.2ppmNOx
120mm/h
Dec.03 10:00
05 17.6% O2
04 0.0% CO2
03 0.9 ppmCO
02 -0.3ppmNOx
120mm/h
Dec.03 09:00
05 19.1% O2
04 0.0% CO2
03 75.6 ppmCO
02 44.2ppmNOx
120mm/h
Dec.03 08:00
07:50 120mm/h
0 10 20 30 40 50 60 70 80 90 100
ONIZUKA AIR FORCE BASE
TESTED BY PACIFIC ENVIRONMENTAL SERVICES INC
13100 BROOKS DR SUITE 100
BALDWIN PARK CA 91706
(818) 856-1400
MSTV-1
TESTERS
S. HERNANDEZ
M. KEARNEY
M. BROWN



05 0.0% O2
04 0.0% CO2
03 0.7 ppmCO
02 0.1ppmNOx
120mm/h
Dec.03 13:00
0 10 20 30 40 50 60 70 80 90 100
05 17.5% O2
04 2.1% CO2
03 65.5 ppmCO
02 35.7ppmNOx
120mm/h
Dec.03 12:00
0 10 20 30 40 50 60 70 80 90 100
05 0.0% O2
04 0.0% CO2
03 0.9 ppmCO
02 0.1ppmNOx
120mm/h
Dec.03 11:00
0 10 20 30 40 50 60 70 80 90 100


ONIZUKA AIR FORCE BASE
TESTED BY PACIFIC ENVIRONMENTAL SERVICES INC
BROOKS SUITE
BALDWIN PARK CA 91706
(818) 856-1400
TESTERS
HERNANDEZ
KEARNEY
BROWN
STV-1
0
10
20
30
40
50
60
70
80
90
100
05 11.0% O2
04 0.0% CO2
03 50.6 ppmCO
02 23.3ppmNOx
120mm/h
Dec.03 15:00
05 17.5% O2
04 2.2% CO2
03 65.4 ppmCO
02 36.7ppmNOx
120mm/h
Dec.03 14:00

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No. F028.000	Page 1 of 8
Client ONIZUKA, AFB	
Location SUNNYVALE, CA	

Prepared By	Date	Checked By	Date	Sheet Title VAC @ START 19.8" Hg – 19.8" @ END (24" ø STACK) RUN 1 (CARB 20)
[signature]	12-3	N/A	-	

TIME	NOx	CO	CO_2	O_2	NOTES.		
--	0.0	0.9	0.0	0.0	ZERO	@ NOx 0.0	← ≈09:20
--	44.2	75.6	~~19.0~~	19.0	H-SPAN	44.4	
--	23.1	51.0	2.3	11.0	M-SPAN	22.3	
--	10.7	--	--	--	L-SPAN	10.4	
08:23	26.8	--	--	--	CONVERTER CHECK (NO_x)		
08:53	26.5	--	--	--	END CONVERTER CHECK		
08:26	--	--	--	17.6	O_2 TRAVERSE	R 8	(4) SE
--	--	--	--	17.6		R 7	(3)
--	--	--	--	17.6		R 6	(2)
--	--	--	--	17.6		R 5	(1)
--	--	--	--	17.6	NO STRATIFICATION FOUND	R 4	(4) NE
--	--	--	--	17.6		R 3	(3)
--	--	--	--	17.7		R 2	(2)
--	--	--	--	17.6		R 1	(1)
--	43.8	75.5	2.2	19.0	BIAS (HIGH)		

START RUN 1

TIME	NOx	CO	CO_2	O_2	NOTES
09:56	34.7	66.6	2.1	17.5	@ R 4 F/S CO_2 = ~~10%~~ 5%
09:57	34.7	66.6	2.1	17.5	@ 0.250 VDC
09:58	34.0	65.2	2.1	17.6	
09:59	33.1	64.2	2.1	17.7	
10:00	33.2	64.2	2.1	17.7	
10:01	33.2	64.1	2.1	17.7	
10:02	33.3	64.2	2.1	17.7	
10:03	33.4	64.4	2.1	17.7	
10:04	33.5	64.4	2.1	17.7	
10:05	33.4	64.1	2.1	17.7	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page 2 of 8
F028.000	
Client	
ONIZUKA AFB	
Location	
SUNNYVALE, CA	

Prepared By	Date	Checked By	Date	Sheet Title
SWH	12-3	N/A	—	RUN 1

TIME	NOx	CO	CO_2	O_2	NOTES:
10:06	33.5	64.4	~~17.7~~ 2.1	17.7	
10:07	33.5	64.3	2.1	17.7	
10:08	33.5	64.3	2.1	17.7	
10:09	33.5	64.3	2.1	17.7	
10:10	33.6	64.1	2.1	17.7	~~MOVED to P 3 SWH~~
10:11	33.6	64.2	2.1	17.7	
10:12	33.6	64.2	2.1	17.7	
10:13	33.7	64.3	2.1	17.7	
10:14	33.7	64.1	2.1	17.7	
10:15	33.6	63.8	2.0	17.7	(20 MIN)
10:16	33.5	63.9	2.1	17.7	
10:17	33.7	64.1	2.1	17.7	ACTUAL POINT CHANGE
10:18	34.6	65.2	2.1	17.6	< CHANGES OBSERVED ON STRIP CHART.
10:19	35.2	66.4	2.1	17.6	
10:20	35.3	66.7	2.1	17.6	
10:21	35.5	66.9	2.1	17.5	
10:22	35.4	66.6	2.1	17.5	
10:23	35.5	66.5	2.1	17.5	
10:24	35.5	66.5	2.1	17.5	
10:25	35.5	66.5	2.1	17.5	(30 MIN)
10:26	35.3	66.5	2.1	17.5	
10:27	35.2	66.5	2.1	17.6	
10:28	35.1	66.6	2.1	17.5	
10:29	35.0	66.6	2.1	17.5	
10:30	34.7	66.3	2.1	17.6	
10:31	34.7	66.0	2.1	17.6	
10:32	35.0	66.0	2.1	17.6	
10:33	35.0	66.0	2.1	17.6	
10:34	34.6	65.6	2.1	17.6	
10:35	34.9	65.8	2.1	17.6	(40 MIN)

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page 3 of 8
Client: ONIZUKA AFB	
Location: SUNNYVALE, CA	

Prepared By	Date	Checked By	Date	Sheet Title
Sam	12-3	N/A	-	RUN 1

TIME	NOx	CO	CO_2	O_2	NOTES:
10:36	34.9	65.8	2.1	17.6	
10:37	34.9	65.9	2.1	17.6	
10:38	34.8	65.9	2.1	17.6	← MOVED to Pt 3
10:39	34.8	65.8	2.1	17.6	
10:40	34.8	66.0	2.1	17.6	
10:41	34.9	66.2	2.1	17.6	
10:42	34.8	66.2	2.1	17.6	
10:43	34.8	66.4	2.1	17.6	
10:44	34.9	66.3	2.1	17.5	
10:45	34.8	66.3	2.1	17.6	(50 MIN)
10:46	34.8	66.4	2.1	17.5	
10:47	34.7	66.2	2.1	~~34.7~~ 17.5	
10:48	34.7	66.5	2.1	17.5	
10:49	34.8	66.2	2.1	17.6	
10:50	34.7	66.2	2.1	17.6	
10:51	34.7	66.0	2.1	17.6	
10:52	34.7	66.1	2.1	17.6	$\bar{x}$ CO =
10:53	34.6	66.1	2.1	17.6	$\bar{x}$ CO_2 =
10:54	34.6	66.4	2.1	17.5	$\bar{x}$ O_2 =
10:55	34.4	66.4	2.1	17.6	(60 MIN) $\bar{x}$ NOx =

- -	0.2	1.0	0.0	0.0	ZERO
- -	44.4	75.4	4.0	19.0	H-SPAN
- -	23.1	50.8	2.2	11.0	M-SPAN
- -	10.2	- -	- -	- -	L-SPAN
- -	43.7	75.5	2.2	19.0	BIAS

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
F028.000	4	8

Client: ONIZUKA AFB

Location: SUNNYVALE, CA

Prepared By	Date	Checked By	Date	Sheet Title
SAH	12-3	N/A	-	RUN 2

TIME	NOx	CO	CO_2	O_2	NOTES
11:52	35.6	65.9	2.2	17.5	START TEST PT4 SE PORT
11:53	35.6	66.0	2.2	17.5	
11:54	35.6	65.8	2.1	17.5	
11:55	35.6	65.7	2.1	17.5	
11:56	35.6	65.8	2.1	17.5	
11:57	35.8	65.9	2.1	17.5	
11:58	35.8	65.8	2.1	17.5	
11:59	35.7	65.5	2.1	17.5	
12:00	35.6	65.5	2.1	17.5	
12:01	35.6	65.7	2.1	17.5	(10 MIN)
12:02	35.6	66.0	2.1	17.5	
12:03	35.6	66.0	2.2	17.5	
12:04	35.5	66.0	2.1	17.5	
12:05	35.6	66.0	2.1	17.5	
12:06	35.7	66.0	2.1	17.5	
12:07	36.0	65.9	2.1	17.5	
12:08	36.1	66.0	2.2	17.5	
12:09	36.0	66.0	2.1	17.5	
12:10	36.0	66.3	2.1	17.5	
12:11	36.1	66.0	2.1	17.5	(20 MIN) [MOVE to R 3] *
12:12	35.5	66.5	2.1	17.5	
12:13	35.3	66.7	2.1	17.5	
12:14	35.5	66.5	2.1	17.5	
12:15	35.5	66.5	2.1	17.5	
12:16	35.3	66.5	2.1	17.5	
12:17	35.5	~~35.5~~ 66.4	2.1	17.5	
12:18	35.9	66.4	2.1	17.5	
12:19	35.7	66.7	2.1	17.5	
12:20	36.1	66.4	2.1	17.5	
12:21	36.2	66.1	2.1	17.5	(30 MIN)

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
F028.000	5	8

Client: ONIZUKA AFB

Location: SUNNYVALE, CA

Prepared By	Date	Checked By	Date	Sheet Title
[illegible]	12.3	N/A	—	RUN 2

TIME	NOx	CO	CO_2	O_2	NOTES.
12:22	36.3	66.2	2.1	17.5	
12:23	36.4	66.2	2.1	17.5	
12:24	36.4	66.1	2.1	17.5	
12:25	36.2	66.1	2.1	17.5	
12:26	36.2	66.4	2.1	17.5	
12:27	36.3	66.3	2.1	17.5	
12:28	36.4	66.2	2.1	17.4	
12:29	36.2	66.1	2.1	17.5	
12:30	36.2	66.2	2.1	17.5	
12:31	36.1	66.2	2.1	17.5	(40 MIN) [SWITCHED to R2]
12:32	36.1	66.2	2.1	17.5	
12:33	36.0	66.1	2.1	17.5	
12:34	36.0	66.0	2.1	17.5	
12:35	36.1	65.9	2.1	17.5	
12:36	36.1	66.0	2.1	17.5	
12:37	36.1	65.9	2.1	17.5	
12:38	36.1	65.8	2.1	17.5	
12:39	36.0	65.8	2.1	17.5	
12:40	36.0	65.9	2.1	17.5	
12:41	35.9	65.8	2.1	17.5	(50 MIN)
12:42	35.8	65.7	2.1	17.5	
12:43	35.8	65.9	2.1	17.5	
12:44	35.8	65.8	2.1	17.5	
12:45	35.7	65.8	2.1	17.5	
12:46	35.7	65.8	2.1	17.5	
12:47	35.6	65.8	2.1	17.5	
12:48	35.6	65.8	2.1	17.5	
12:49	35.6	65.9	2.1	17.5	
12:50	35.5	65.8	2.1	17.5	
12:51	35.6	65.8	2.1	17.5	(60 MIN)

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
F028.000	6	8

Client: ONIZUKA AFB

Location: SUNNYVALE, CA

Prepared By	Date	Checked By	Date	Sheet Title
[signature]	12-3	N/A	–	RUN 3

TIME	NOx	CO	CO_2	O_2	NOTES:	
--	0.1	0.7	-0.1	0.0	ZERO	+0.01
--	44.6	75.2	3.8	19.0	H-SPAN	3.9%
--	23.3	50.5	2.1	11.0	M-SPAN	--
--	10.3	--	--	--	L-SPAN	--
--	44.0	75.0	--	18.9	BIAS	--
13:46	36.4	65.5	2.2	17.4		START AT R 2 SE
13:47	36.5	65.5	2.2	17.5		
13:48	36.6	65.5	2.2	17.5		
13:49	36.6	65.6	2.2	17.5		
13:50	36.7	65.6	2.2	17.5		
13:51	36.7	65.7	2.2	17.5		
13:52	36.6	65.6	2.2	17.5		
13:53	36.6	65.7	2.2	17.4		
13:54	36.6	65.6	2.2	17.4		
13:55	36.7	65.6	2.2	17.4	(10 MIN)	
13:56	36.8	65.8	2.2	17.4		
13:57	36.6	65.9	2.2	17.4		
13:58	36.6	65.6	2.2	17.4		
13:59	36.6	65.5	2.2	17.5		
14:00	36.6	65.4	2.2	17.5		
14:01	36.5	65.3	2.2	17.5		
14:02	36.5	65.5	2.2	17.5		
14:03	36.6	65.6	2.2	17.5		
14:04	36.6	65.6	2.2	17.5		
14:05	36.5	65.5	2.2	17.5	(20 MIN)	MOVED TO R 3 SE

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page
F028.000	7 of 8

Client: ONIZUKA AFB

Location: SUNNYVALE, CA

Prepared By	Date	Checked By	Date	Sheet Title
SMH	12-3	N/A	–	RUN 3

TIME	NO_x	CO	CO_2	O_2	NOTES:
14:06	36.3	65.5	2.2	17.5	
14:07	36.2	65.1	2.2	17.5	
14:08	36.3	65.3	2.2	17.5	
14:09	36.3	65.5	2.2	17.5	
14:10	36.3	65.6	2.2	17.5	
14:11	36.3	65.4	2.2	17.5	
14:12	36.3	65.5	2.2	17.5	
14:13	36.4	65.5	2.2	17.5	
14:14	36.5	65.4	2.2	17.5	
14:15	36.4	65.5	2.2	17.5	(30 MIN)
14:16	36.3	65.4	2.2	17.5	
14:17	36.5	65.5	2.2	17.5	
14:18	36.7	65.6	2.2	17.5	
14:19	36.7	65.7	2.2	17.5	
14:20	36.5	65.8	2.2	17.5	
14:21	36.5	65.6	2.2	17.5	
14:22	36.7	65.5	2.2	17.5	
14:23	36.6	65.5	2.2	17.5	
14:24	36.6	65.5	2.2	17.5	
14:25	36.4	65.5	2.2	17.5	(40 MIN) MOVED to R 4 SE
14:26	36.4	65.5	2.2	17.5	
14:27	36.3	65.5	2.2	17.5	
14:28	36.2	65.5	2.2	17.5	
14:29	36.2	65.5	2.2	17.5	
14:30	36.0	63.7	2.1	17.6	PROBE MOVED FOR PM_{10}
14:31	36.2	65.6	2.2	17.5	
14:32	36.0	65.6	2.2	17.5	
14:33	36.3	65.8	2.2	17.5	
14:34	36.4	65.6	2.2	17.5	
14:35	36.5	65.8	2.2	17.5	(50 MIN)

PACIFIC ENVIRONMENTAL SERVICES, INC.

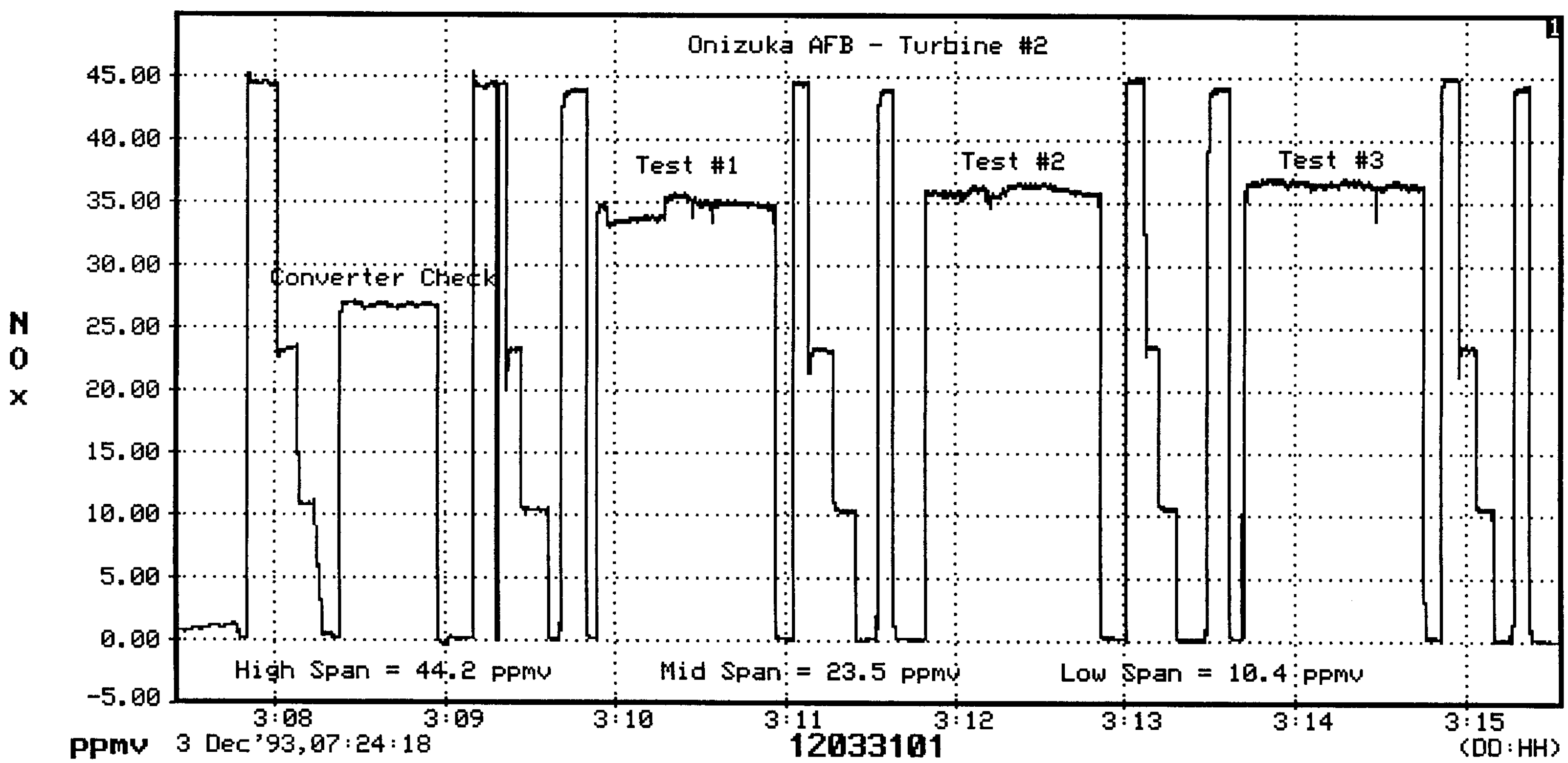
Project No.	Page	of
F028.000	8	8

Client
ONIZUKA AFB

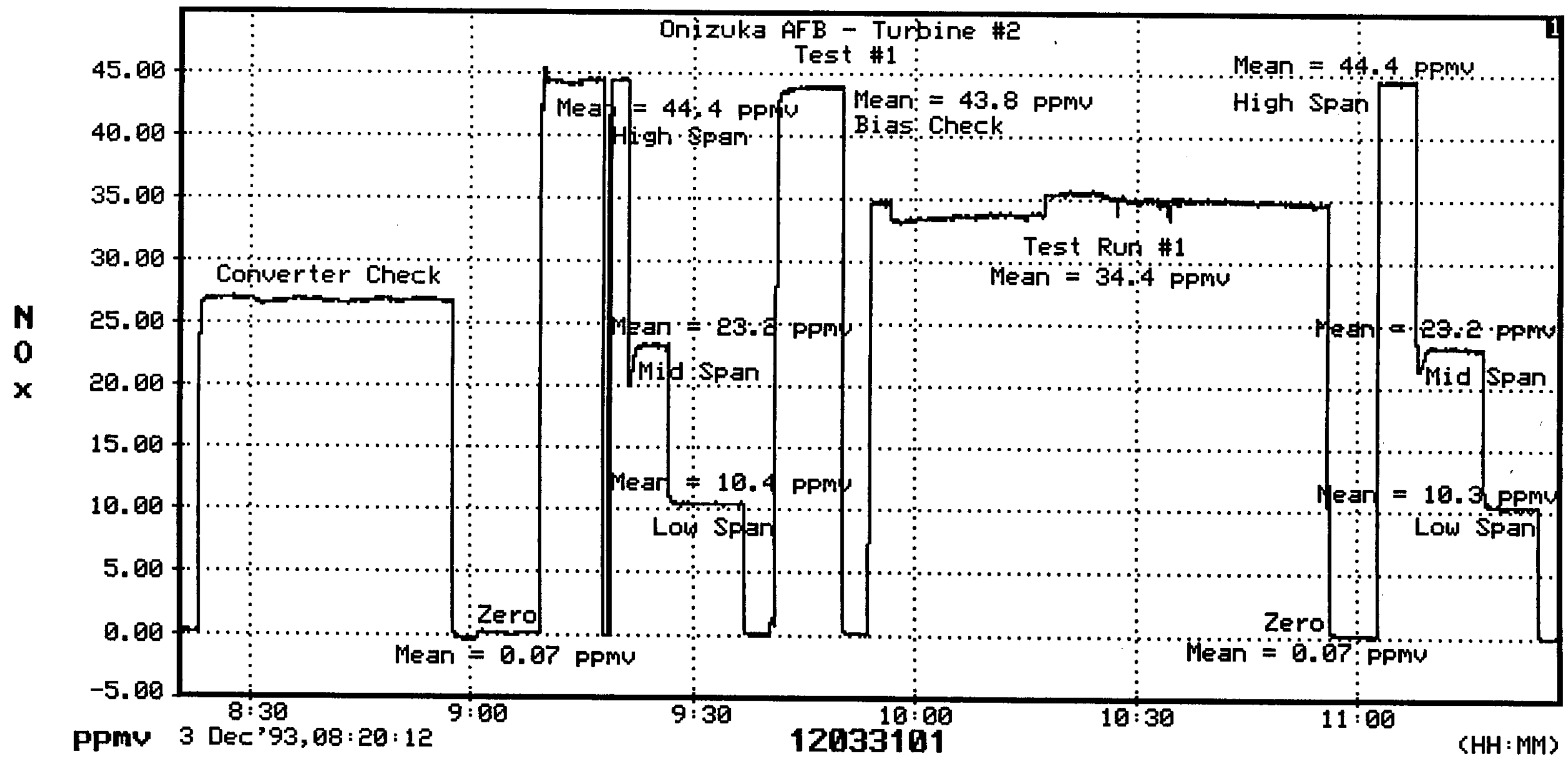
Location
SUNNYVALE, CA

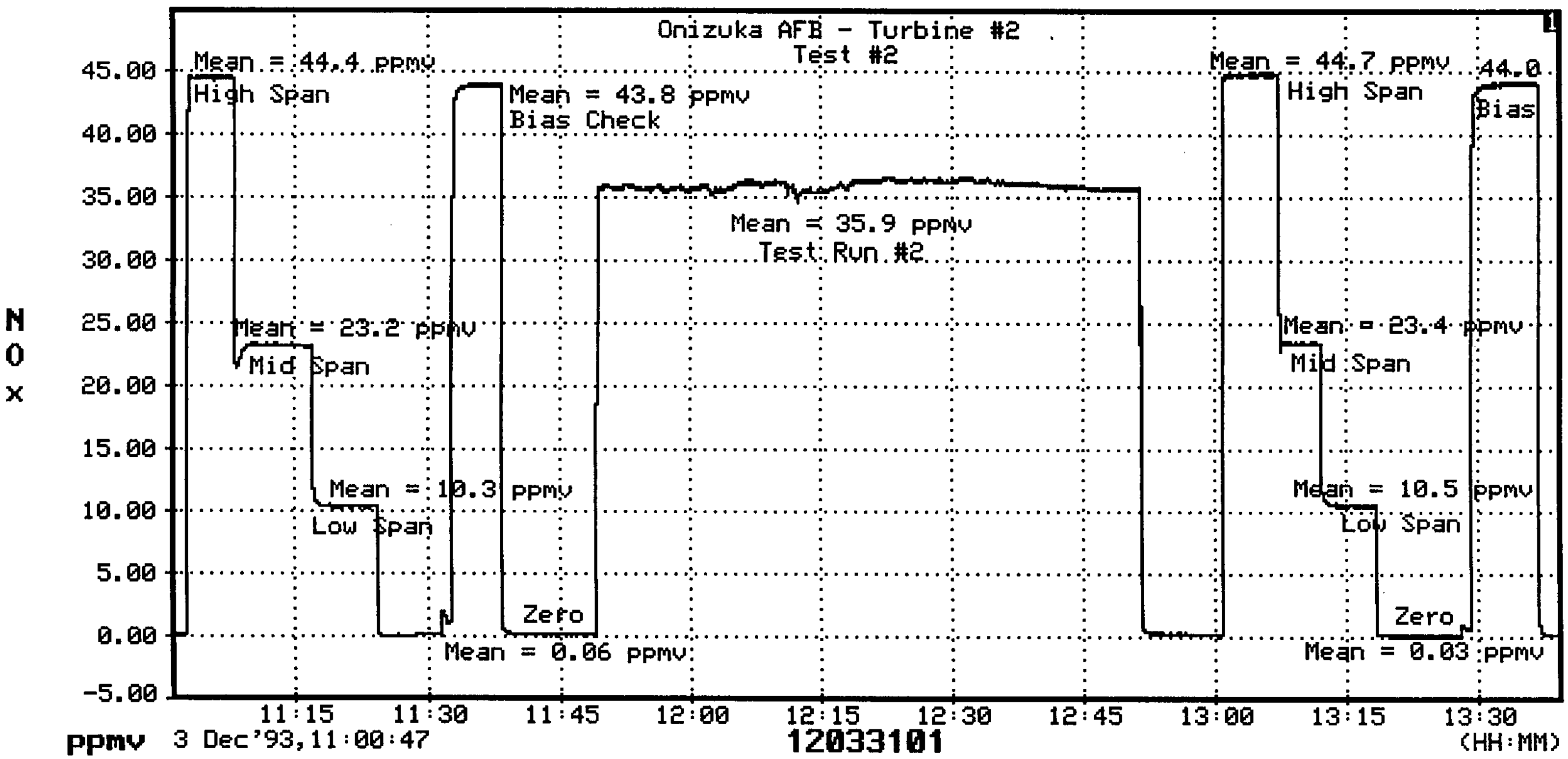
Prepared By	Date	Checked By	Date	Sheet Title
[illegible]	12-3	N/A	–	RUN 3

TIME	NO_x	CO	CO_2	O_2	NOTES:
14:36	36.5	65.9	2.2	17.5	
14:37	36.5	66.0	2.2	17.5	
14:38	36.4	65.8	2.2	17.5	
14:39	36.4	66.1	2.2	17.5	
14:40	36.4	66.2	2.2	17.4	
14:41	36.2	66.3	2.2	17.5	
14:42	36.2	66.2	2.2	17.5	
14:43	36.3	66.0	2.2	17.5	
14:44	36.3	66.2	2.2	17.5	
14:45	36.2	66.4	2.2	17.5	(60 MIN)
--	0.[illegible]	0.7	0.0	0.0	ZERO
--	44.8	75.1	3.9	19.1	H-SPAN
--	23.3	50.5	2.2	11.0	M-SPAN
--	10.4	--	--	--	L-SPAN
--	~~43.7~~	75.0	2.2	19.0	BIAS
15:–	44.1				END OF TEST.

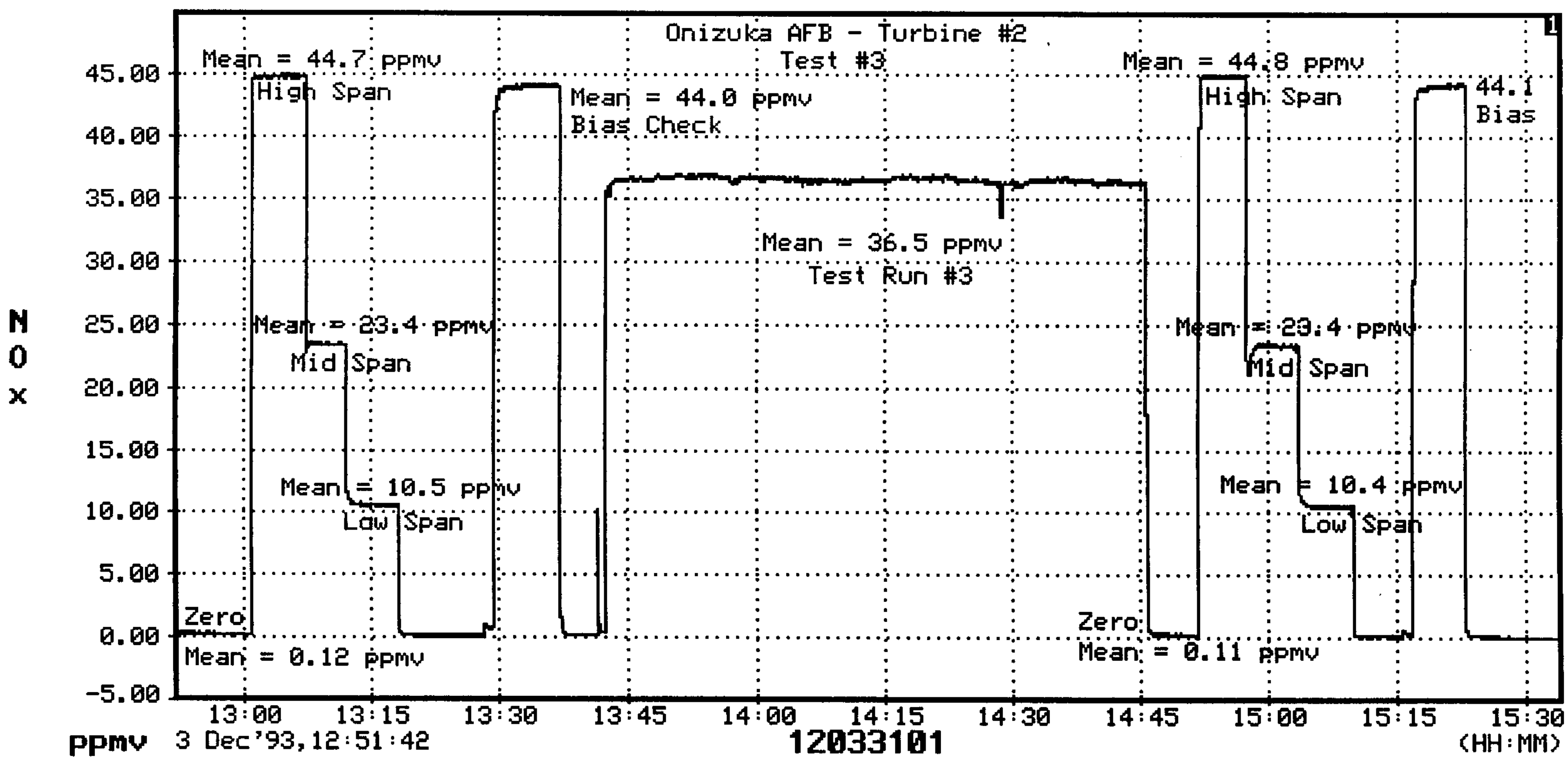


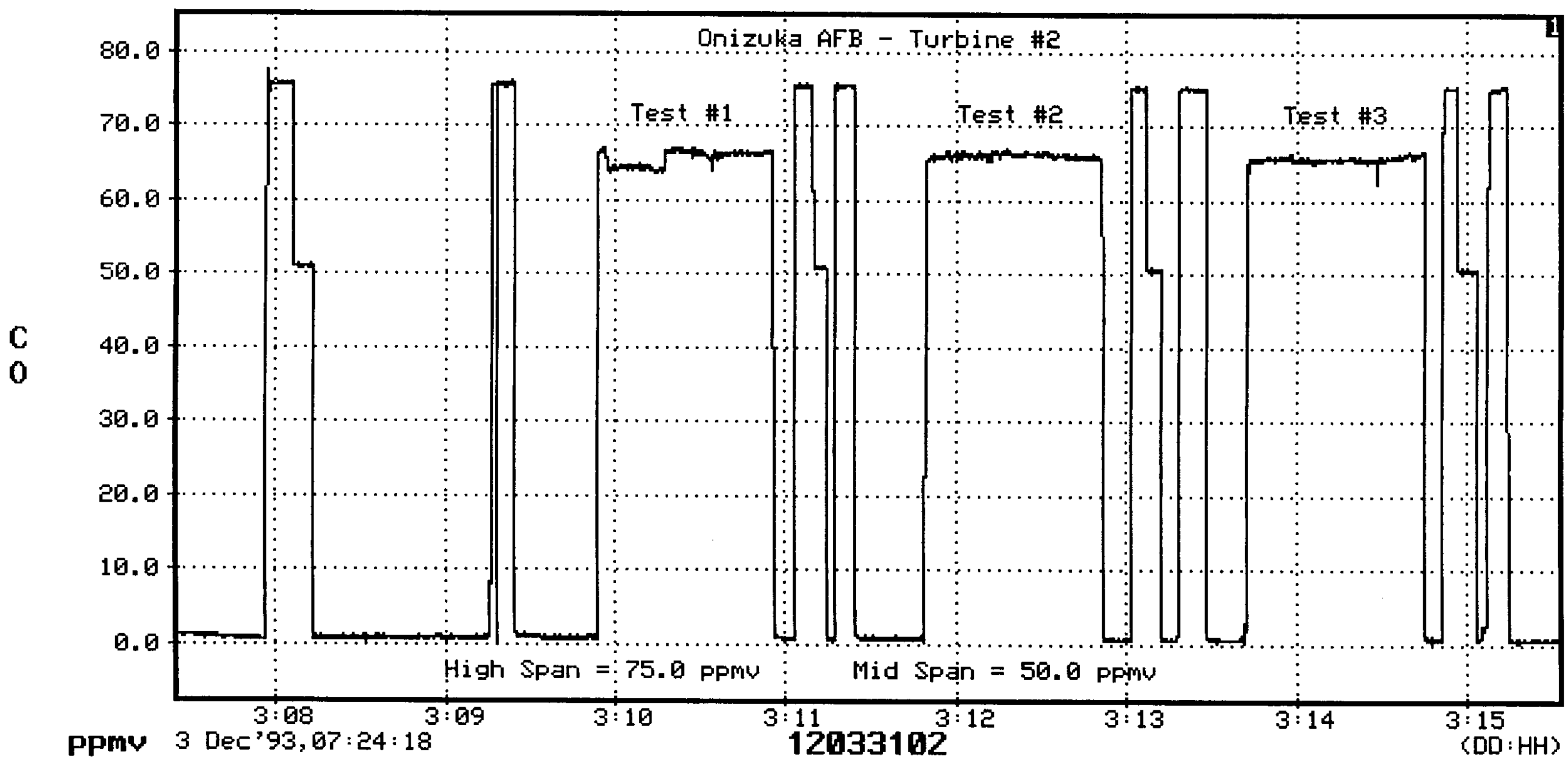
Onizuka AFB - Turbine #2
Test #1
Test #2
Test #3
Converter Check
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
NOx
ppmv
High Span = 44.2 ppmv
Mid Span = 23.5 ppmv
Low Span = 10.4 ppmv
3:08
3:09
3:10
3:11
3:12
3:13
3:14
3:15
(DD:HH)
3 Dec'93,07:24:18
12033101


Onizuka AFB - Turbine #2
Test #1
NOx
ppmv
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
Converter Check
Zero
Mean = 0.07 ppmv
Mean = 44.4 ppmv
High Span
Mean = 23.2 ppmv
Mid Span
Mean = 10.4 ppmv
Low Span
Mean = 43.8 ppmv
Bias Check
Test Run #1
Mean = 34.4 ppmv
Mean = 44.4 ppmv
High Span
Mean = 23.2 ppmv
Mid Span
Mean = 10.3 ppmv
Low Span
Zero
Mean = 0.07 ppmv
8:30
9:00
9:30
10:00
10:30
11:00
(HH:MM)
3 Dec'93,08:20:12
12033101

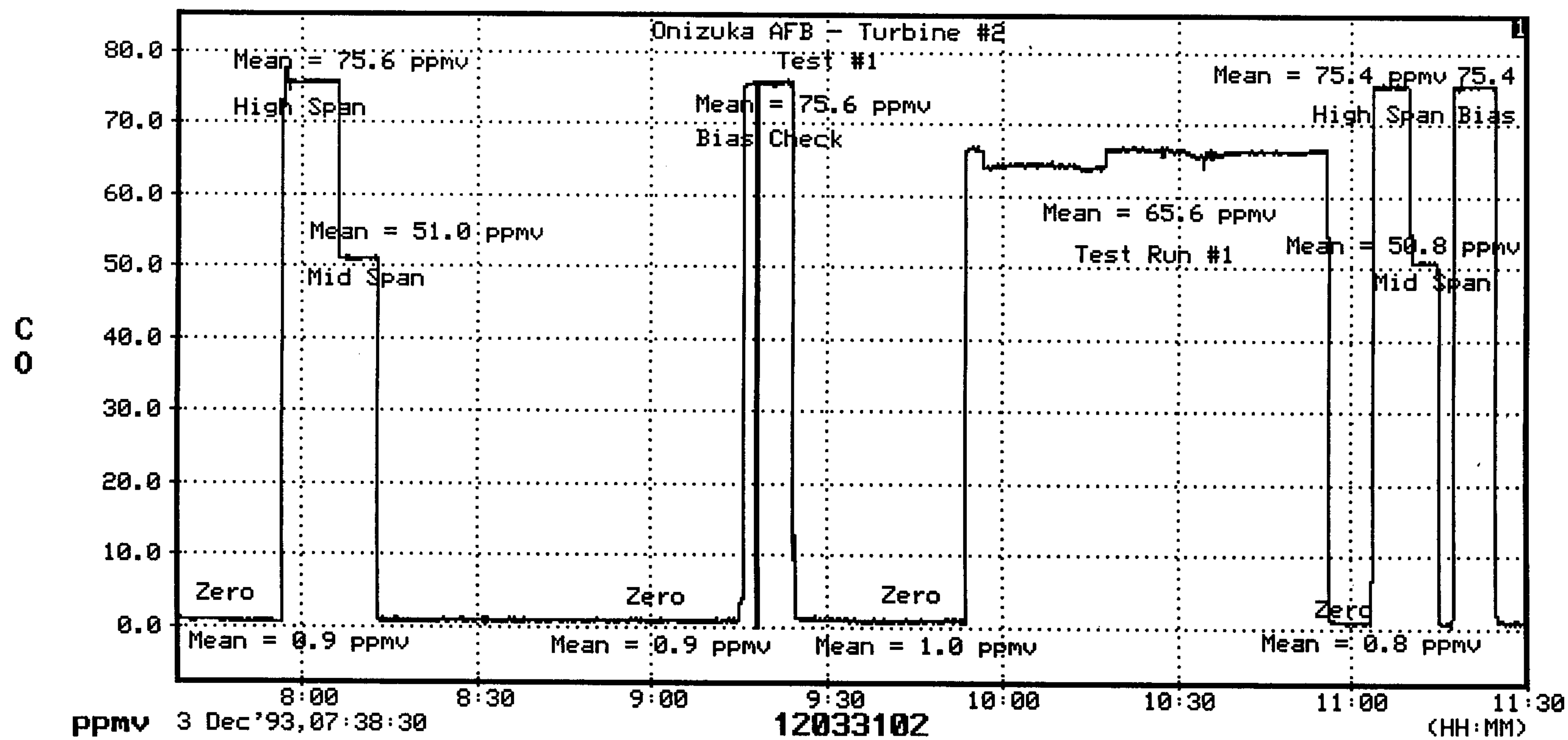


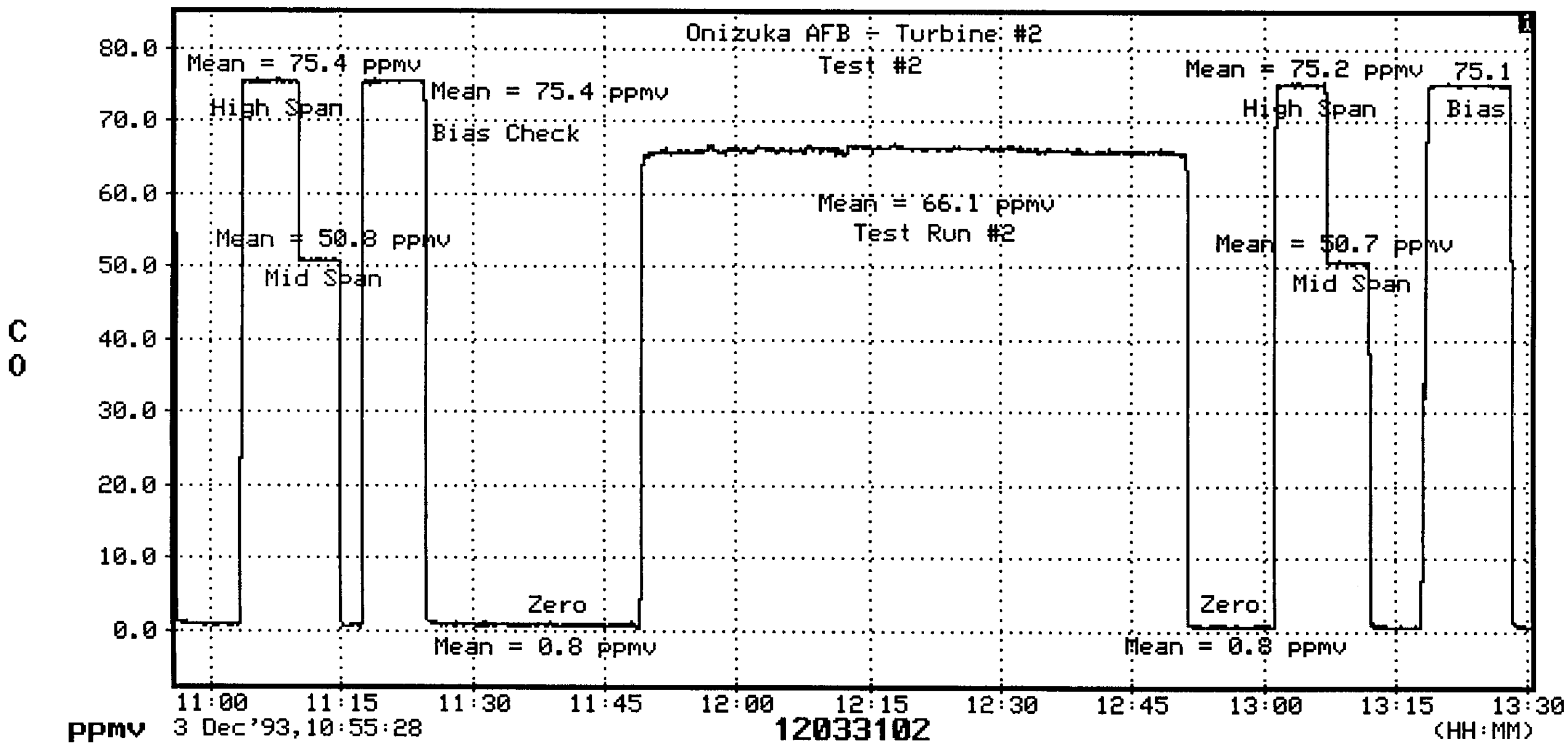
Onizuka AFB - Turbine #2
Test #2
Mean = 44.4 ppmv
High Span
Mean = 23.2 ppmv
Mid Span
Mean = 10.3 ppmv
Low Span
Mean = 43.8 ppmv
Bias Check
Zero
Mean = 0.06 ppmv
Mean = 35.9 ppmv
Test Run #2
Mean = 44.7 ppmv
High Span
Mean = 23.4 ppmv
Mid Span
Mean = 10.5 ppmv
Low Span
Zero
Mean = 0.03 ppmv
44.0
Bias
NOx
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
ppmv
11:15
11:30
11:45
12:00
12:15
12:30
12:45
13:00
13:15
13:30
(HH:MM)
3 Dec'93,11:00:47
12033101


Onizuka AFB - Turbine #2
Test #3
Mean = 44.7 ppmv
High Span
Mean = 23.4 ppmv
Mid Span
Mean = 10.5 ppmv
Low Span
Zero
Mean = 0.12 ppmv
Mean = 44.0 ppmv
Bias Check
Mean = 36.5 ppmv
Test Run #3
Mean = 44.8 ppmv
High Span
Mean = 23.4 ppmv
Mid Span
Mean = 10.4 ppmv
Low Span
Zero
Mean = 0.11 ppmv
44.1
Bias
N O x
ppmv
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
13:00
13:15
13:30
13:45
14:00
14:15
14:30
14:45
15:00
15:15
15:30
(HH:MM)
3 Dec'93,12:51:42
12033101

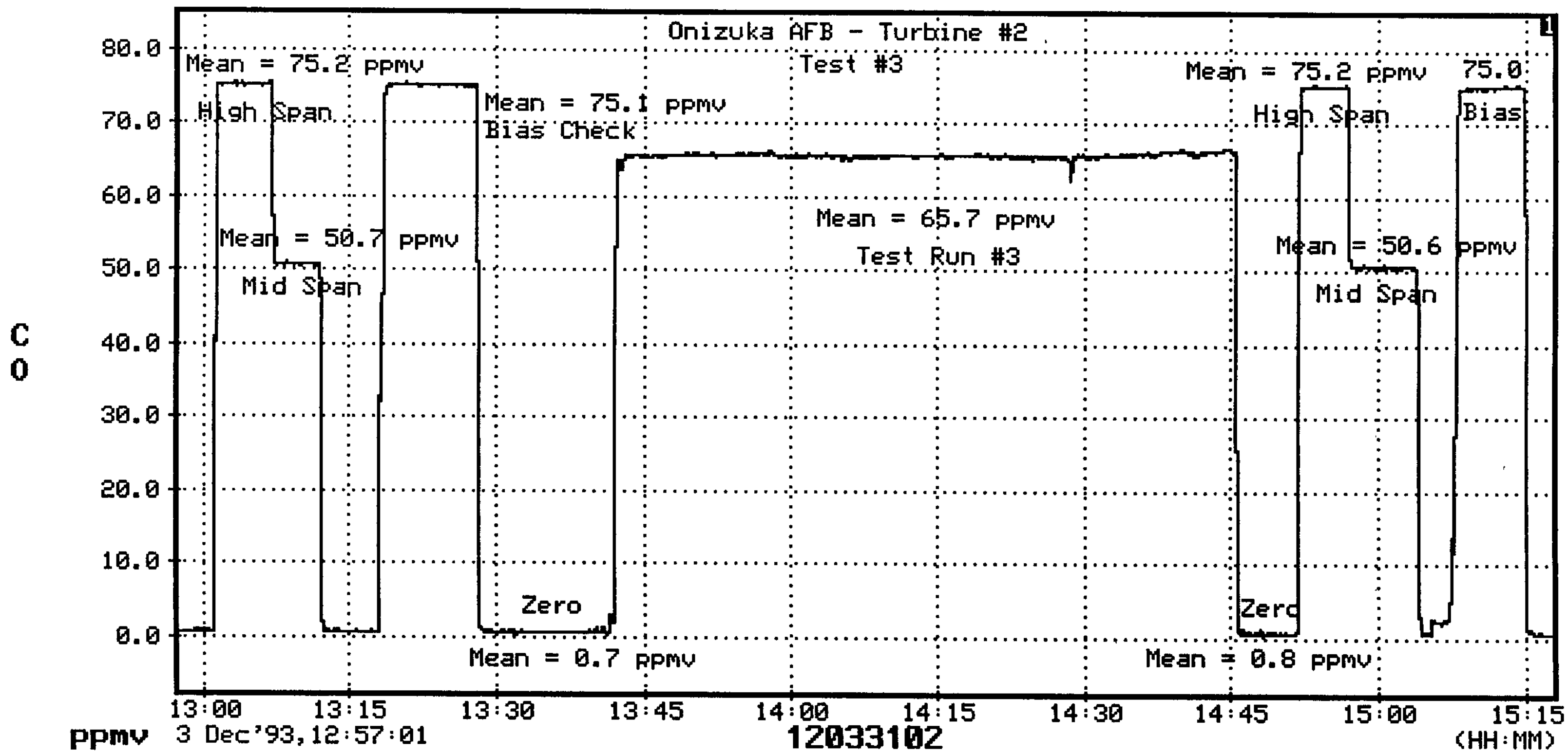


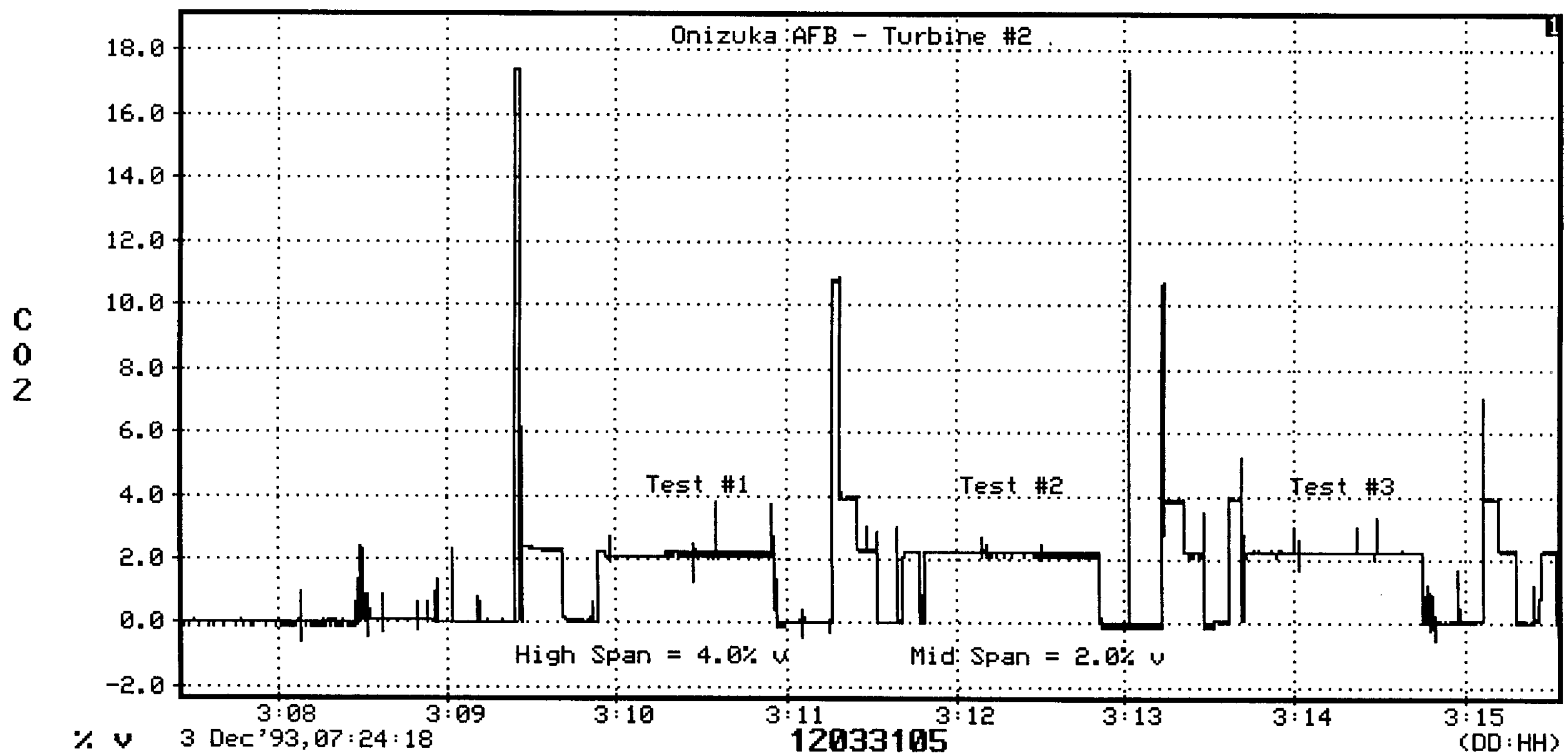
Onizuka AFB - Turbine #2
C
O
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
ppmv
Test #1
Test #2
Test #3
High Span = 75.0 ppmv
Mid Span = 50.0 ppmv
3:08
3:09
3:10
3:11
3:12
3:13
3:14
3:15
(DD:HH)
3 Dec'93,07:24:18
12033102


C
O
Onizuka AFB - Turbine #2
Test #1
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
ppmv
Mean = 75.6 ppmv
High Span
Mean = 51.0 ppmv
Mid Span
Zero
Mean = 0.9 ppmv
Zero
Mean = 0.9 ppmv
Mean = 75.6 ppmv
Bias Check
Zero
Mean = 1.0 ppmv
Mean = 65.6 ppmv
Test Run #1
Mean = 75.4 ppmv 75.4
High Span Bias
Mean = 50.8 ppmv
Mid Span
Zero
Mean = 0.8 ppmv
8:00
8:30
9:00
9:30
10:00
10:30
11:00
11:30
(HH:MM)
3 Dec'93,07:38:30
12033102

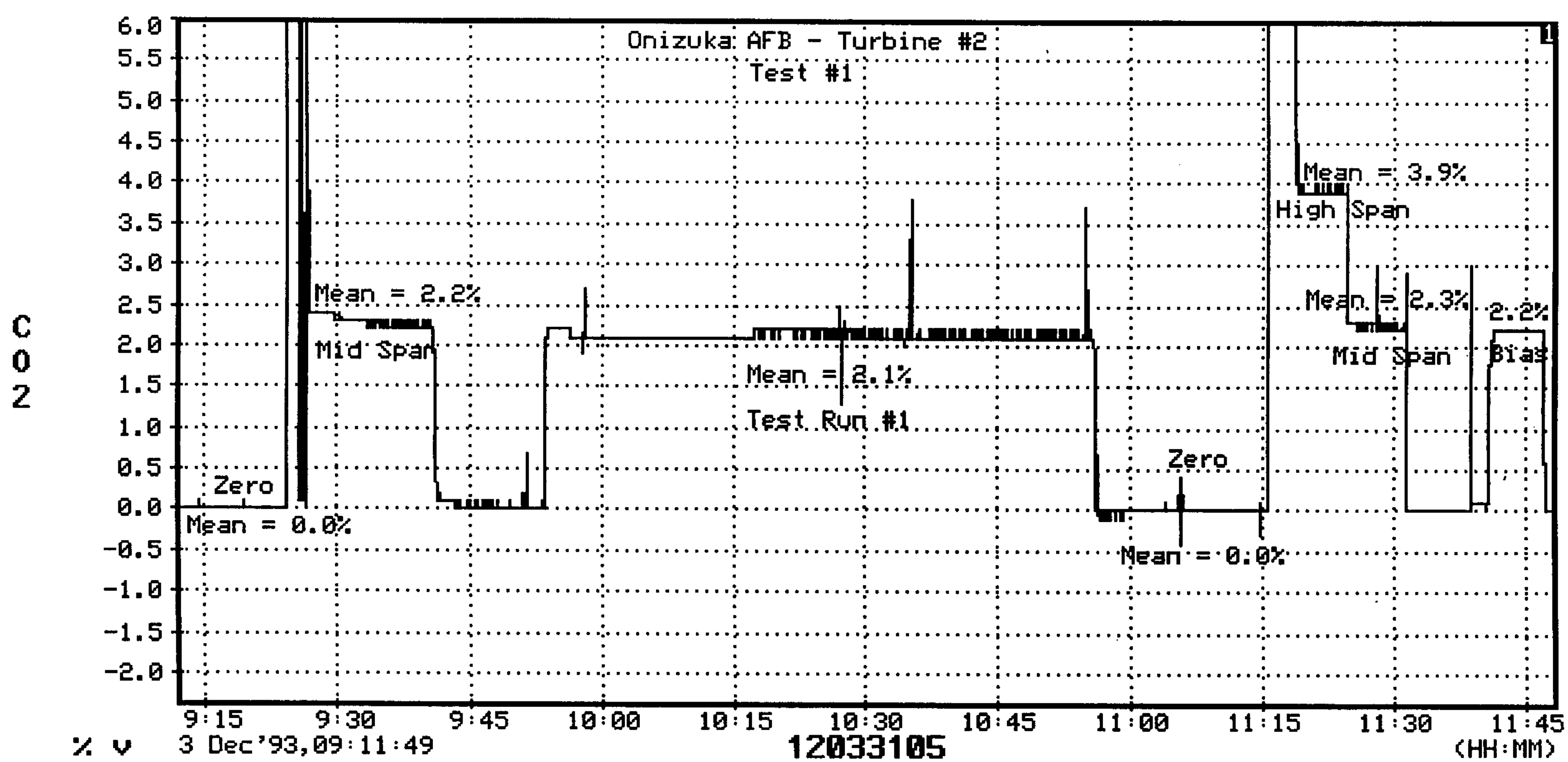


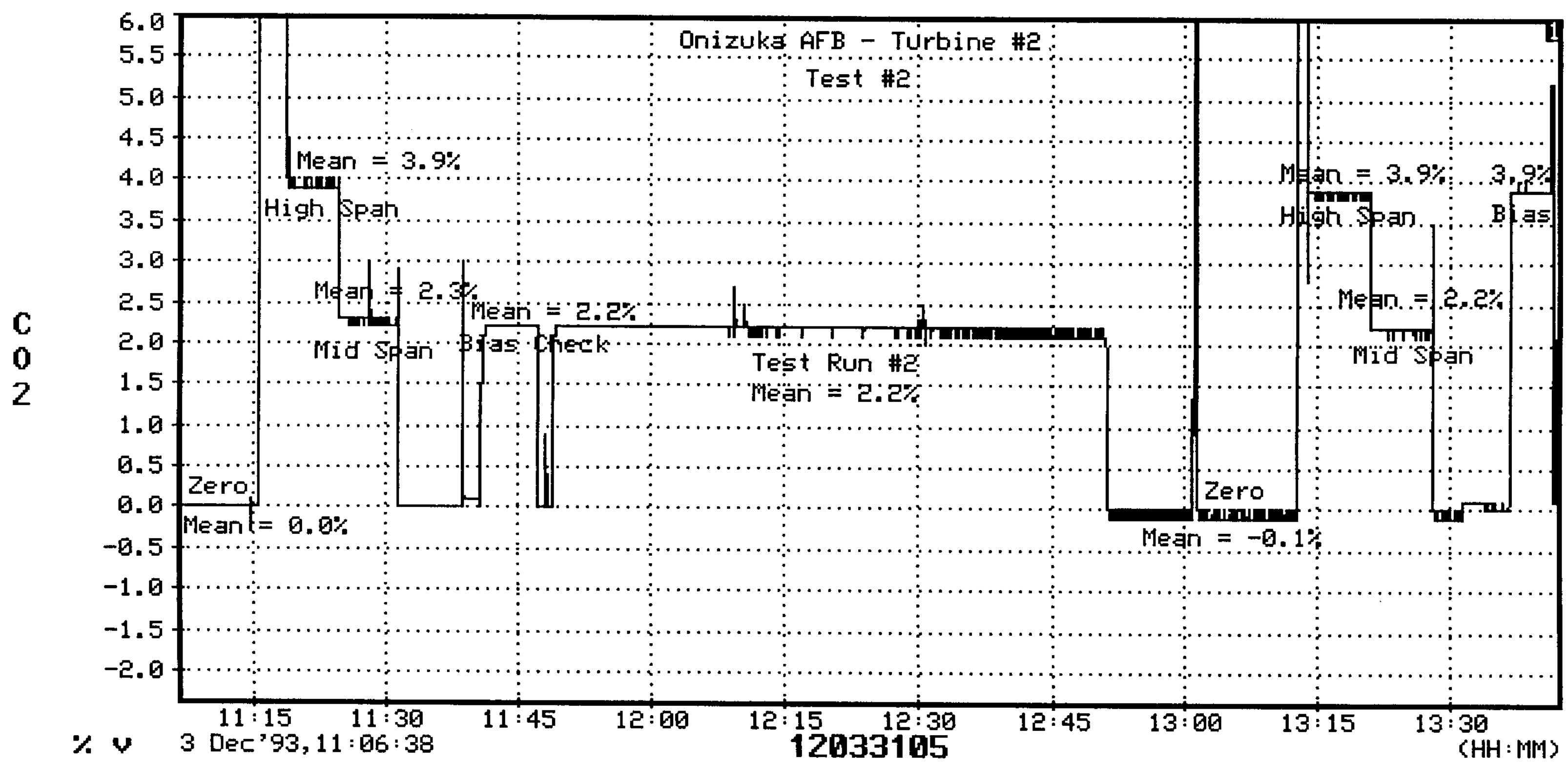
Onizuka AFB - Turbine #2
Test #2
Mean = 75.4 ppmv
High Span
Mean = 50.8 ppmv
Mid Span
Mean = 75.4 ppmv
Bias Check
Zero
Mean = 0.8 ppmv
Mean = 66.1 ppmv
Test Run #2
Mean = 75.2 ppmv
High Span
Mean = 50.7 ppmv
Mid Span
75.1
Bias
Zero
Mean = 0.8 ppmv
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
C
O
ppmv
11:00
11:15
11:30
11:45
12:00
12:15
12:30
12:45
13:00
13:15
13:30
3 Dec'93,10:55:28
12033102
(HH:MM)

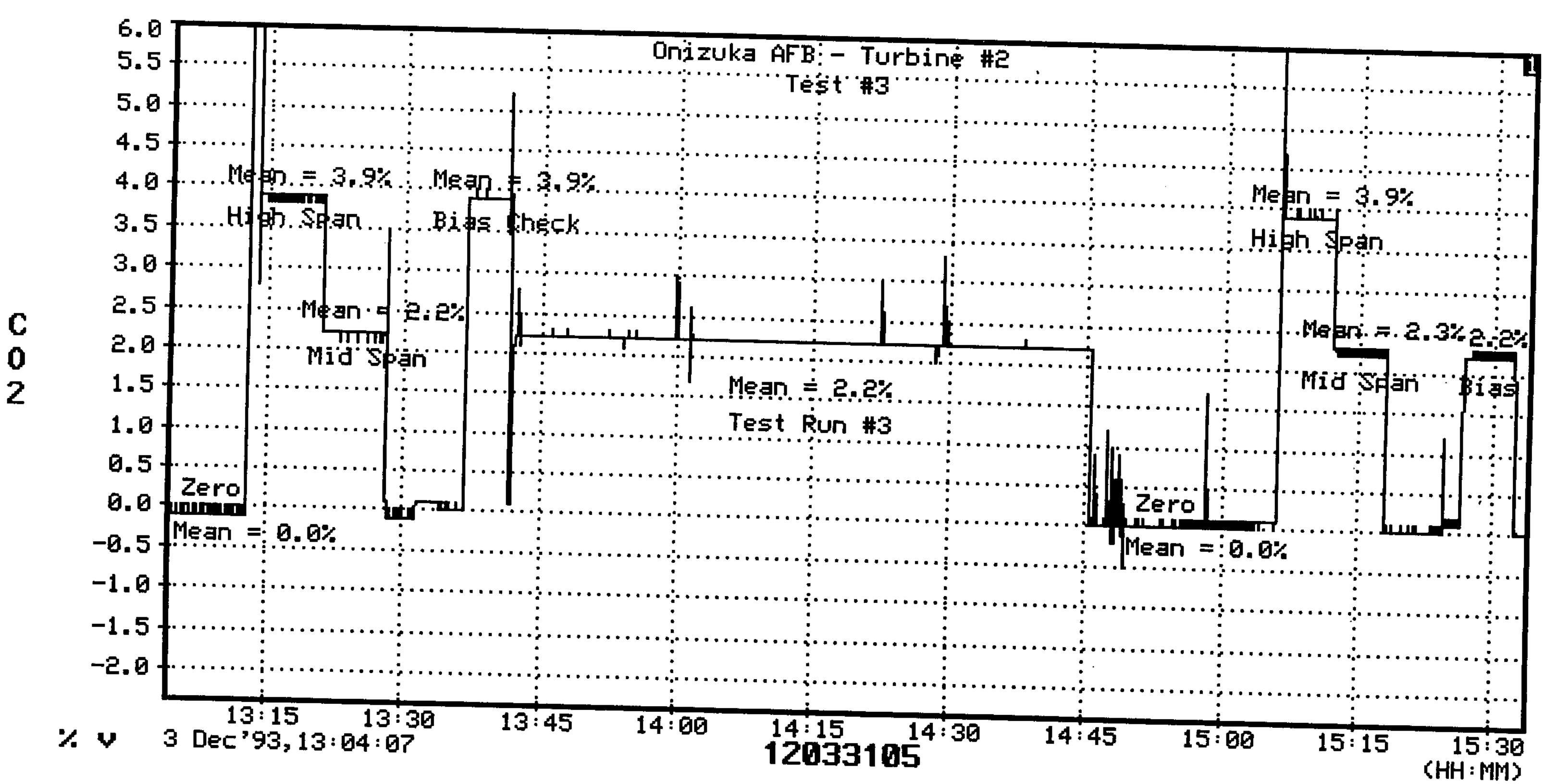

Onizuka AFB - Turbine #2
Test #3
Mean = 75.2 ppmv
High Span
Mean = 50.7 ppmv
Mid Span
Mean = 75.1 ppmv
Bias Check
Zero
Mean = 0.7 ppmv
Mean = 65.7 ppmv
Test Run #3
Mean = 75.2 ppmv
High Span
Mean = 50.6 ppmv
Mid Span
Zero
Mean = 0.8 ppmv
75.0
Bias
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
13:00
13:15
13:30
13:45
14:00
14:15
14:30
14:45
15:00
15:15
(HH:MM)
C
O
ppmv
3 Dec'93,12:57:01
12033102



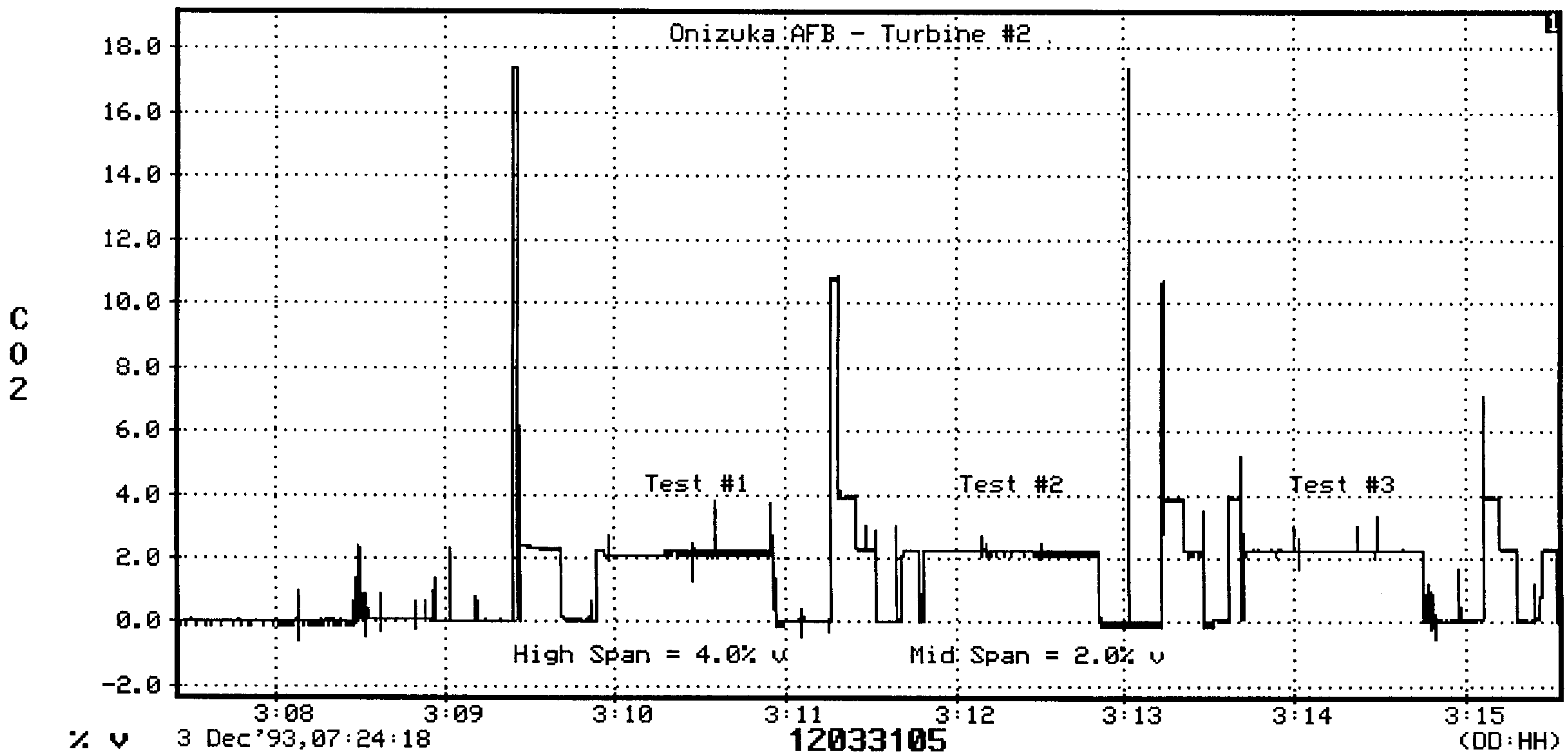
Onizuka AFB - Turbine #2
C
O
2
% v
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
Test #1
Test #2
Test #3
High Span = 4.0% v
Mid Span = 2.0% v
3:08
3:09
3:10
3:11
3:12
3:13
3:14
3:15
(DD:HH)
3 Dec'93,07:24:18
12033105


Onizuka AFB - Turbine #2
Test #1
CO2
% v
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Zero
Mean = 0.0%
Mean = 2.2%
Mid Span
Mean = 2.1%
Test Run #1
Zero
Mean = 0.0%
Mean = 3.9%
High Span
Mean = 2.3%
Mid Span
2.2%
Bias
9:15
9:30
9:45
10:00
10:15
10:30
10:45
11:00
11:15
11:30
11:45
(HH:MM)
3 Dec'93,09:11:49
12033105

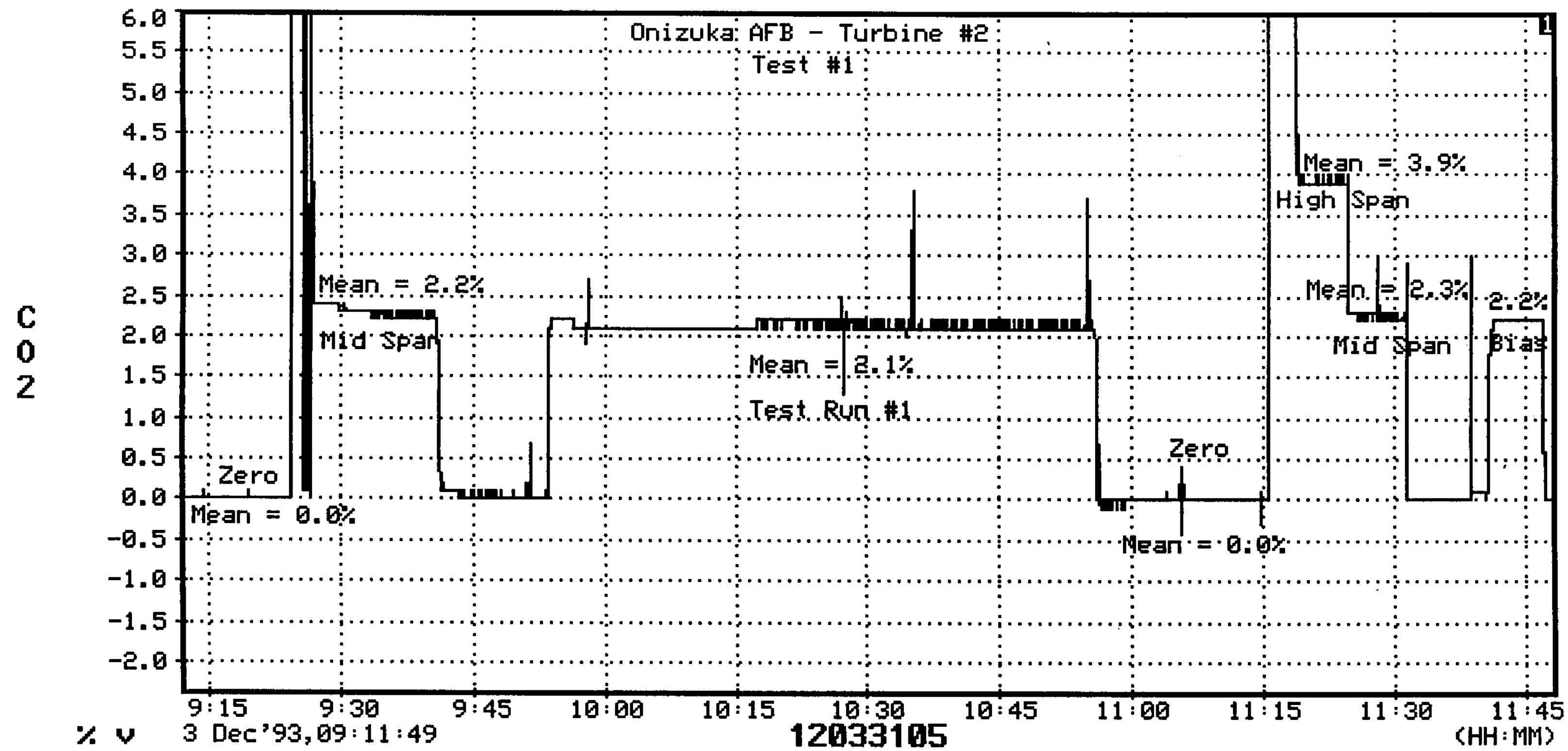

Onizuka AFB - Turbine #2
Test #2
CO2
% v
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Zero
Mean = 0.0%
Mean = 3.9%
High Span
Mean = 2.3%
Mid Span
Mean = 2.2%
Bias Check
Test Run #2
Mean = 2.2%
Zero
Mean = -0.1%
Mean = 3.9%
High Span
Mean = 2.2%
Mid Span
3.9%
Bias
11:15
11:30
11:45
12:00
12:15
12:30
12:45
13:00
13:15
13:30
(HH:MM)
3 Dec'93,11:06:38
12033105

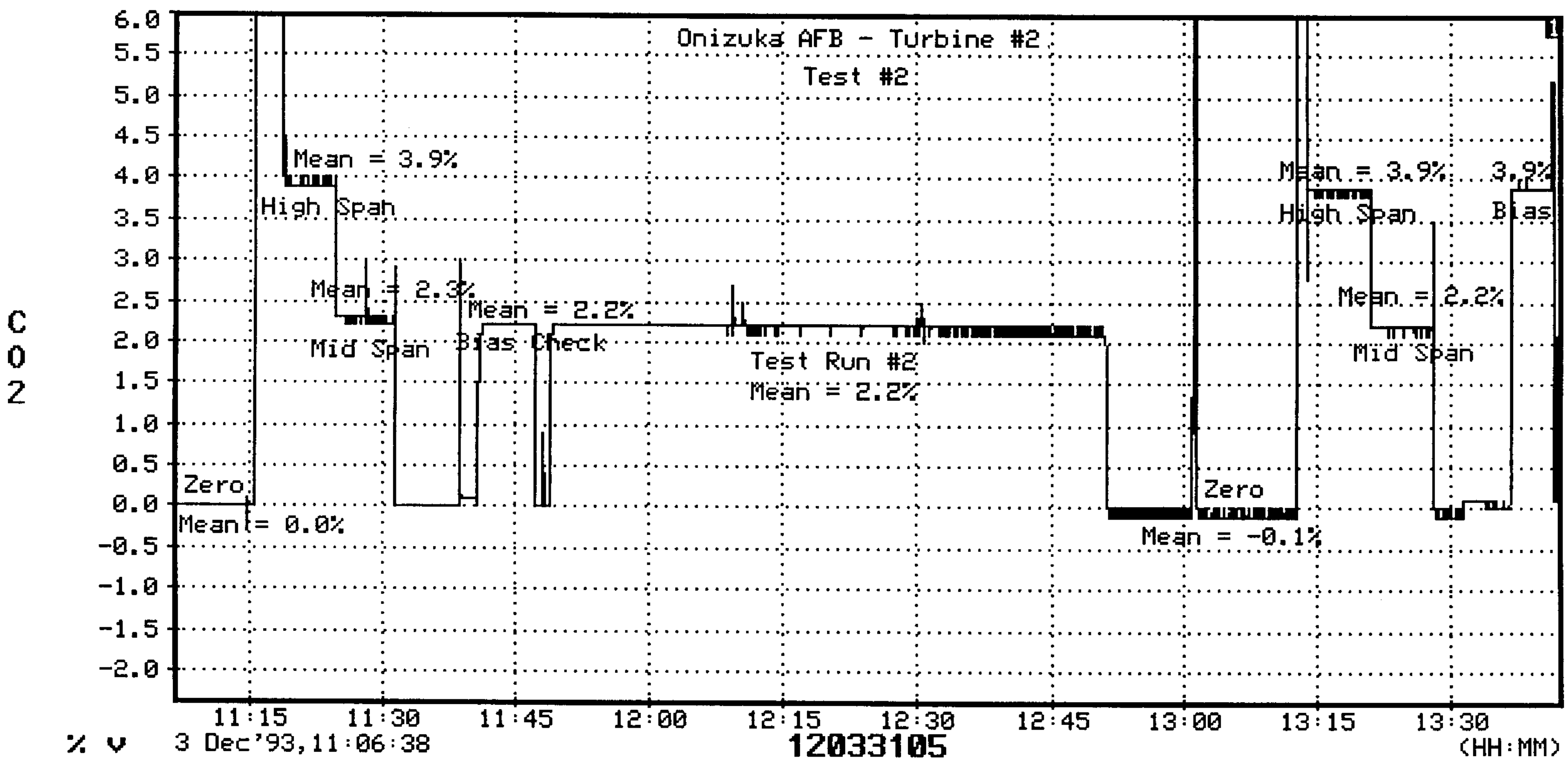


Onizuka AFB - Turbine #2
Test #3
CO2
% v
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Zero
Mean = 0.0%
Mean = 3.9%
High Span
Mean = 2.2%
Mid Span
Mean = 3.9%
Bias Check
Mean = 2.2%
Test Run #3
Zero
Mean = 0.0%
Mean = 3.9%
High Span
Mean = 2.3%
Mid Span
2.2%
Bias
13:15
13:30
13:45
14:00
14:15
14:30
14:45
15:00
15:15
15:30
(HH:MM)
3 Dec'93,13:04:07
12033105

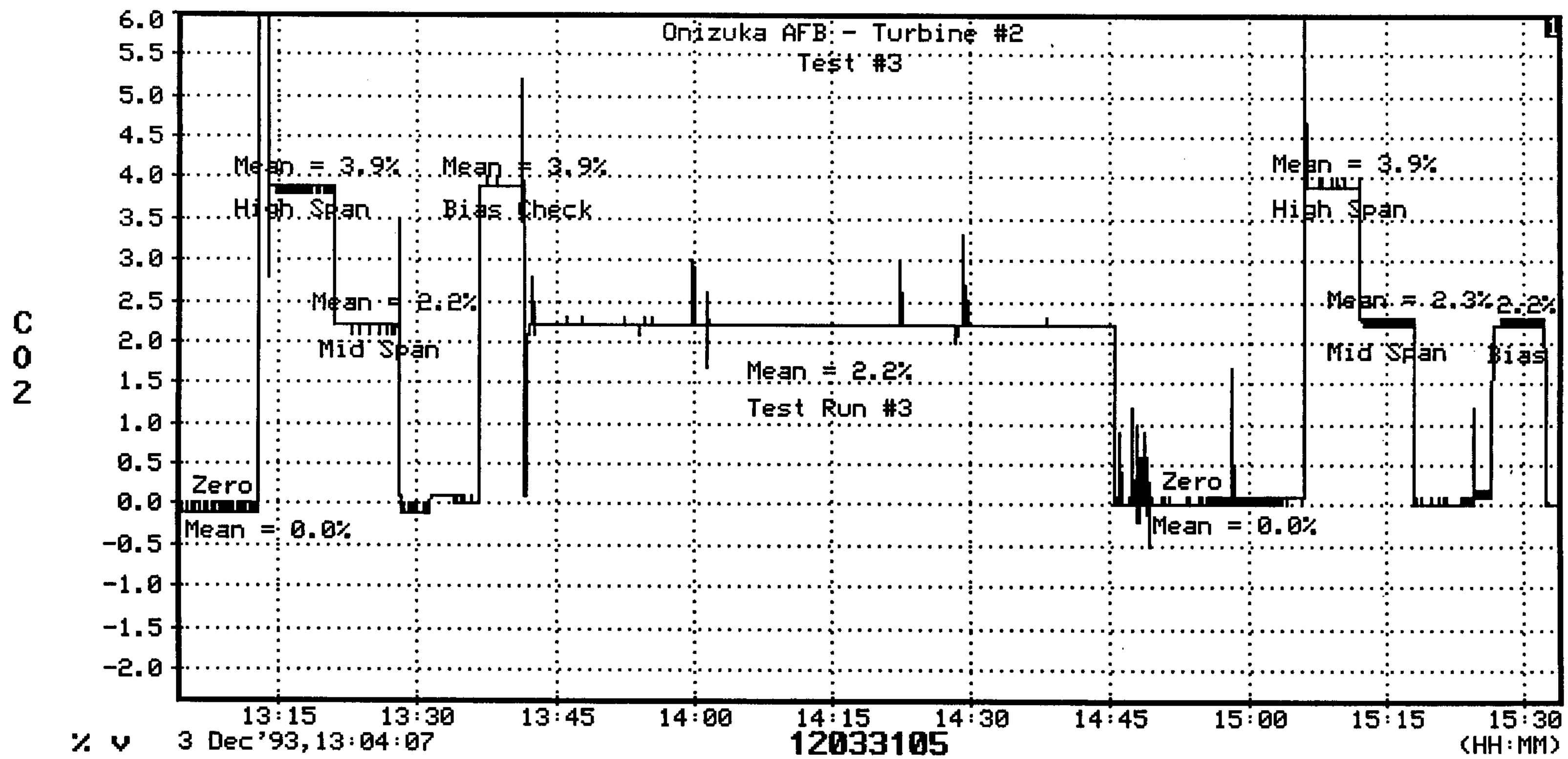


Onizuka AFB - Turbine #2
CO2
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
Test #1
Test #2
Test #3
High Span = 4.0% v
Mid Span = 2.0% v
3:08
3:09
3:10
3:11
3:12
3:13
3:14
3:15
% v
3 Dec'93,07:24:18
12033105
(DD:HH)

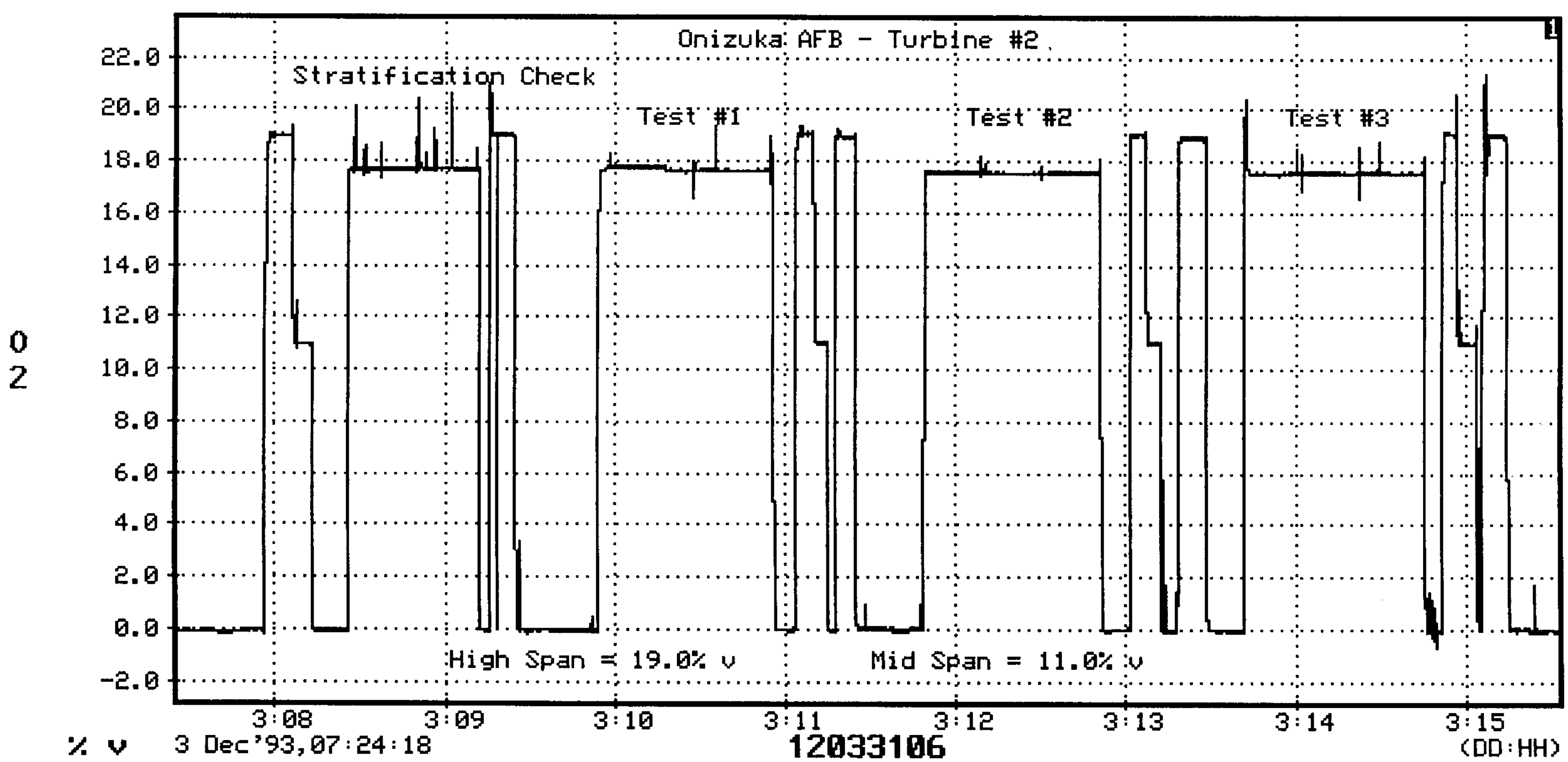

Onizuka AFB - Turbine #2
Test #1
C
O
2
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Zero
Mean = 0.0%
Mean = 2.2%
Mid Span
Mean = 2.1%
Test Run #1
Zero
Mean = 0.0%
Mean = 3.9%
High Span
Mean = 2.3%
Mid Span
2.2%
Bias
9:15
9:30
9:45
10:00
10:15
10:30
10:45
11:00
11:15
11:30
11:45
% v
3 Dec'93,09:11:49
12033105
(HH:MM)



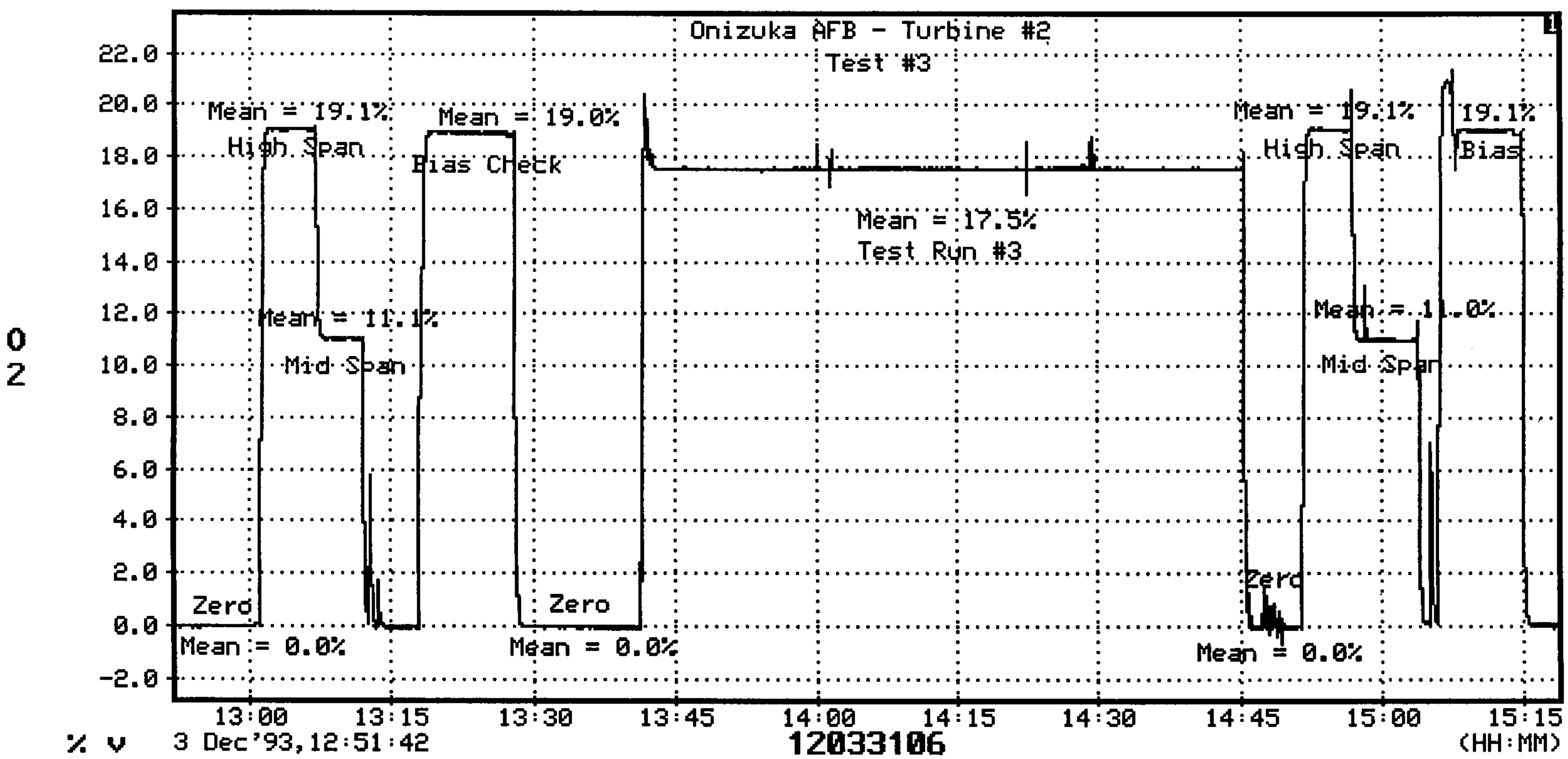
Onizuka AFB - Turbine #2
Test #2
C
O
2
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Zero
Mean = 0.0%
Mean = 3.9%
High Span
Mean = 2.3%
Mid Span
Mean = 2.2%
Bias Check
Test Run #2
Mean = 2.2%
Zero
Mean = -0.1%
Mean = 3.9%
High Span
Mean = 2.2%
Mid Span
3.9%
Bias
11:15
11:30
11:45
12:00
12:15
12:30
12:45
13:00
13:15
13:30
(HH:MM)
% v
3 Dec'93,11:06:38
12033105



Onizuka AFB - Turbine #2
Test #3
C O 2
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Mean = 3.9%
High Span
Mean = 3.9%
Bias Check
Mean = 2.2%
Mid Span
Zero
Mean = 0.0%
Mean = 2.2%
Test Run #3
Zero
Mean = 0.0%
Mean = 3.9%
High Span
Mean = 2.3%
2.2%
Mid Span
Bias
13:15
13:30
13:45
14:00
14:15
14:30
14:45
15:00
15:15
15:30
% v
3 Dec'93,13:04:07
12033105
(HH:MM)



Onizuka AFB - Turbine #2
Stratification Check
Test #1
Test #2
Test #3
High Span = 19.0% v
Mid Span = 11.0% v
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
O
2
% v
3:08
3:09
3:10
3:11
3:12
3:13
3:14
3:15
3 Dec'93,07:24:18
12033106
(DD:HH)

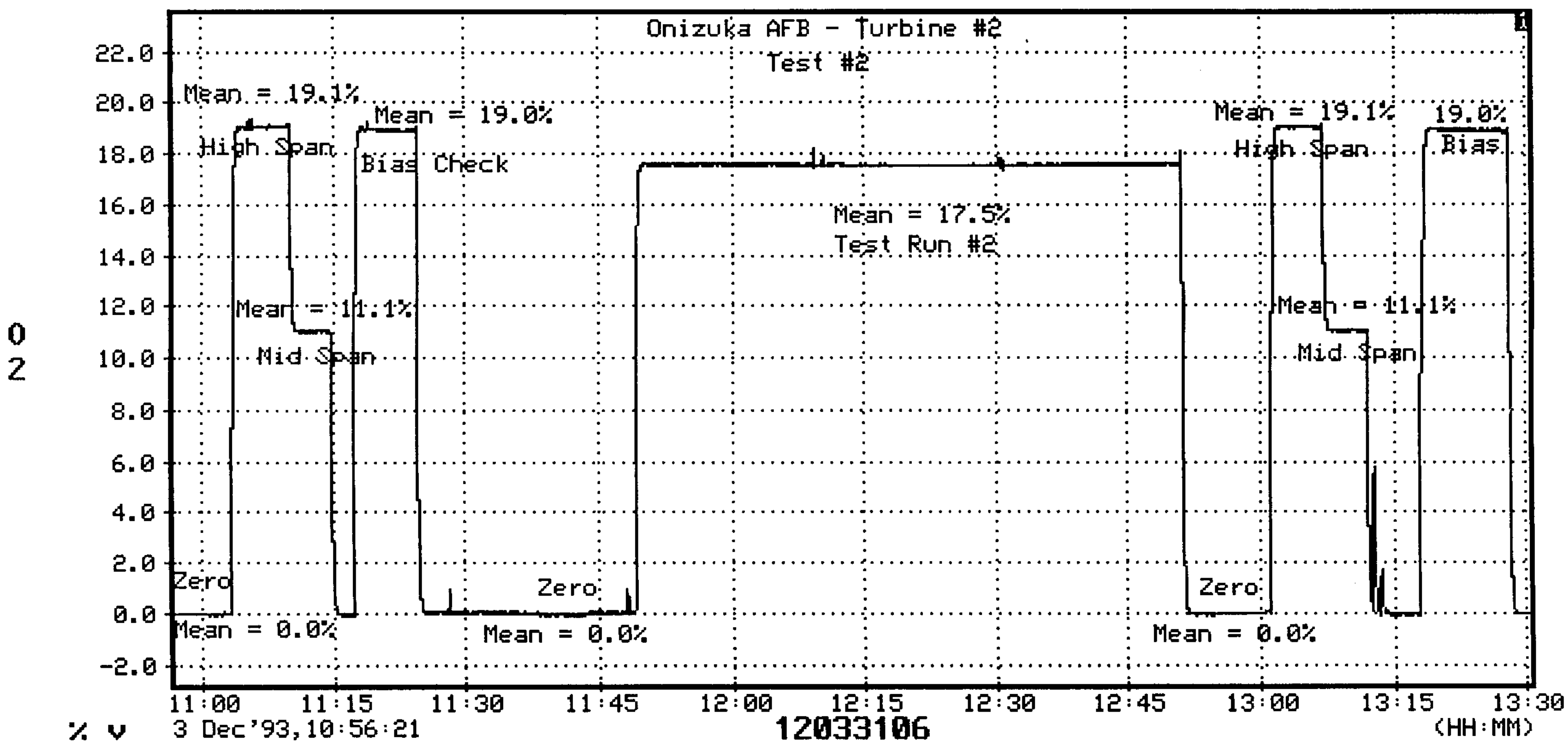

Onizuka AFB - Turbine #2
Test #3
O
2
% v
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
Mean = 19.1%
High Span
Mean = 11.1%
Mid Span
Zero
Mean = 0.0%
Mean = 19.0%
Bias Check
Zero
Mean = 0.0%
Mean = 17.5%
Test Run #3
Mean = 19.1%
High Span
Mean = 11.0%
Mid Span
Zero
Mean = 0.0%
19.1%
Bias
13:00
13:15
13:30
13:45
14:00
14:15
14:30
14:45
15:00
15:15
(HH:MM)
3 Dec'93,12:51:42
12033106

PACIFIC ENVIRONMENTAL SERVICES, INC.

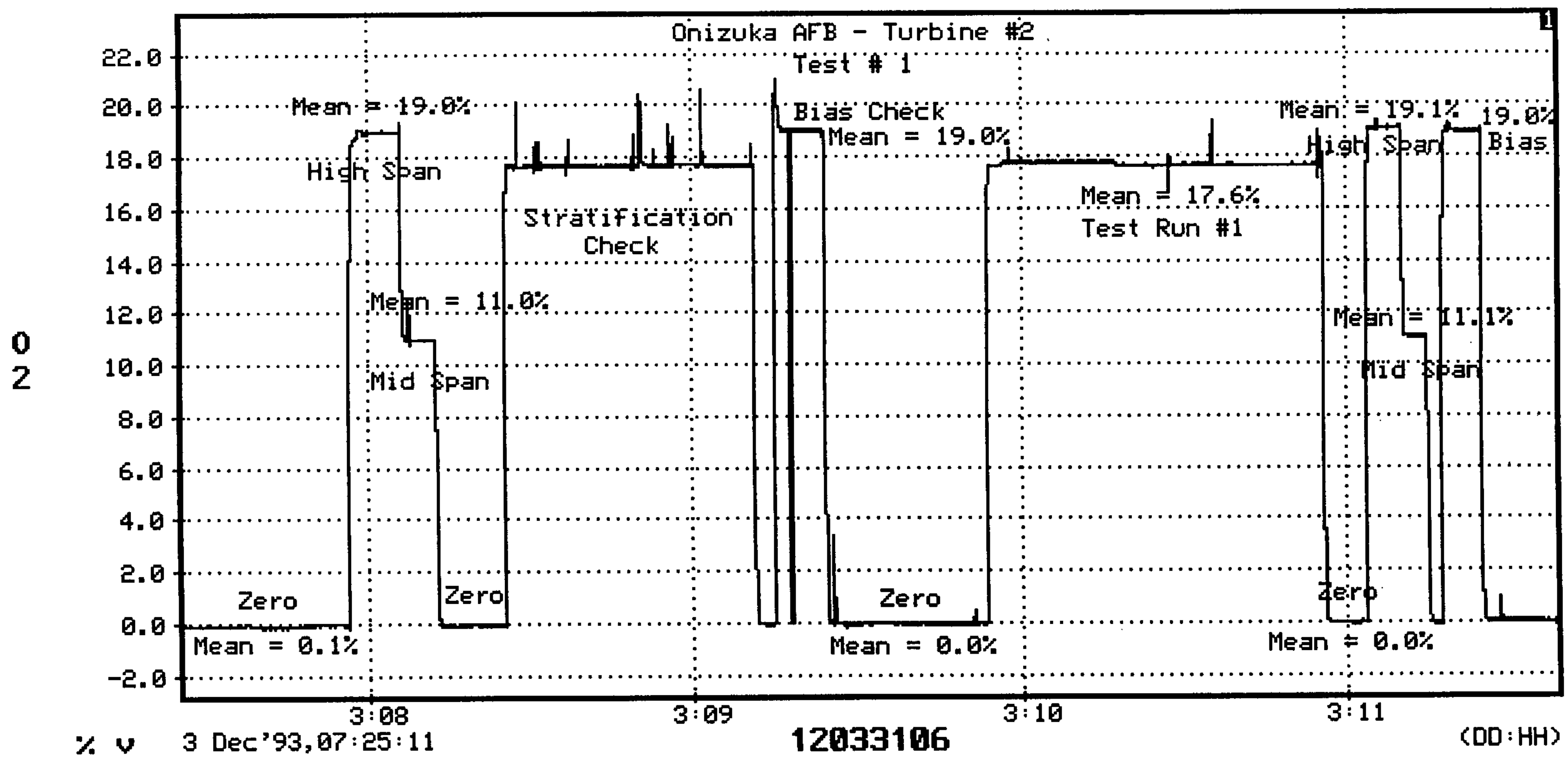
Project No.	F028	Page 1 of 4
Client	ONIZUKA AFB	
Location	TURBINE #2 EXHAUST	

Prepared By	Date	Checked By	Date	Sheet Title
SHB	2/5			CONTINUOUS MONITORING QA/QC

NOx	SPAN VALUE PPMV	PRE-TEST RESPONSE PPMV	PRE-TEST CAL ERROR %F.S.	POST-TEST RESPONSE PPMV	POST-TEST CAL ERROR %F.S.	DRIFT %F.S.
TEST #1						
ZERO	0.00	0.07	0.14	0.07	0.14	0.00
LOW SPAN	10.4	10.4	0.00	10.3	-0.20	-0.20
MID SPAN	23.5	23.2	-0.60	23.2	-0.60	0.00
HIGH SPAN	44.2	44.4	0.40	44.4	0.40	0.00
BIAS	44.2	43.8	-0.80	-	-	-
TEST #2						
ZERO	0.00	0.06	0.12	0.03	0.06	-0.06
LOW SPAN	10.4	10.3	-0.20	10.5	0.20	0.40
MID SPAN	23.5	23.2	-0.60	23.4	-0.20	0.40
HIGH SPAN	44.2	44.4	0.40	44.7	1.00	0.60
BIAS	44.2	43.8	-0.80	-	-	-
TEST #3						
ZERO	0.00	0.12	0.24	0.11	0.22	-0.02
LOW SPAN	10.4	10.5	0.20	10.4	0.00	-0.20
MID SPAN	23.5	23.4	-0.20	23.4	-0.20	0.00
HIGH SPAN	44.2	44.7	1.00	44.8	1.20	0.20
BIAS	44.2	44.0	-0.40	44.1	-0.20	0.20



Onizuka AFB - Turbine #2
Test #2
O
2
% v
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
Mean = 19.1%
High Span
Mean = 19.0%
Bias Check
Mean = 11.1%
Mid Span
Zero
Mean = 0.0%
Zero
Mean = 0.0%
Mean = 17.5%
Test Run #2
Zero
Mean = 0.0%
Mean = 19.1%
High Span
Mean = 11.1%
Mid Span
19.0%
Bias
11:00
11:15
11:30
11:45
12:00
12:15
12:30
12:45
13:00
13:15
13:30
3 Dec'93,10:56:21
12033106
(HH:MM)



O
2
Onizuka AFB - Turbine #2
Test # 1
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
Mean = 19.0%
High Span
Mean = 11.0%
Mid Span
Zero
Mean = 0.1%
Zero
Stratification
Check
Bias Check
Mean = 19.0%
Zero
Mean = 0.0%
Mean = 17.6%
Test Run #1
Mean = 19.1%
High Span
19.0%
Bias
Mean = 11.1%
Mid Span
Zero
Mean = 0.0%
3:08
3:09
3:10
3:11
% v
3 Dec'93,07:25:11
12033106
(DD:HH)

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	F028	Page 2 of 4
Client	ONIZUKA AFB	
Location	TURBINE #2 EXHAUST	

Prepared By	Date	Checked By	Date	Sheet Title
SHB	2/5			CONTINUOUS MONITORING QA/QC

CO	SPAN VALUE PPMV	PRE-TEST RESPONSE PPMV	PRE-TEST CAL ERROR %F.S.	POST-TEST RESPONSE PPMV	POST-TEST CAL ERROR %F.S.	DRIFT %F.S.
TEST #1						
ZERO	0.00	0.9	0.90	0.8	0.80	-0.10
LOW SPAN	—	—	—	—	—	—
MID SPAN	50.0	51.0	1.00	50.8	0.80	-0.20
HIGH SPAN	75.0	75.6	0.60	75.4	0.40	-0.20
BIAS	75.0	75.6	0.60	—	—	—
TEST #2						
ZERO	0.00	0.8	0.80	0.8	0.80	0.00
LOW SPAN	—	—	—	—	—	—
MID SPAN	50.0	50.8	0.80	50.7	0.70	-0.10
HIGH SPAN	75.0	75.4	0.40	75.2	0.20	-0.20
BIAS	75.0	75.4	0.40	—	—	—
TEST #3						
ZERO	0.00	0.7	0.70	0.8	0.80	0.10
LOW SPAN	—	—	—	—	—	—
MID SPAN	50.0	50.7	0.70	50.6	0.60	-0.10
HIGH SPAN	75.0	75.2	0.20	75.2	0.20	0.00
BIAS	75.0	75.1	0.10	75.0	0.00	—

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	F028	Page 3 of 4
Client	ONIZUKA AFB	
Location	TURBINE #2 EXHAUST	

Prepared By	Date	Checked By	Date	Sheet Title
SHB	2/5			CONTINUOUS MONITORING QA/QC

		PRE-TEST		POST-TEST		
CO_2	SPAN VALUE PPMV	RESPONSE PPMV	CAL ERROR %F.S.	RESPONSE PPMV	CAL ERROR %F.S.	DRIFT %F.S.
TEST #1						
ZERO	0.00	0.0	0.00	0.0	0.0	0.00
LOW SPAN	—	—	—	—	—	—
MID SPAN	2.0	2.2	.0	2.3	3.0	1.00
HIGH SPAN	4.0	—	—	3.9	-1.0	—
BIAS	2.0	—	—	2.2	2.0	—
TEST #2						
ZERO	0.00	0.0	0.00	-0.1	-1.0	
LOW SPAN	—	—	—	—	—	—
MID SPAN	2.0	2.3	3.0	2.2	2.0	
HIGH SPAN	4.0	3.9	-1.0	3.9	-1.0	
BIAS	4.0	—	—	3.9	-1.0	—
TEST #3						
ZERO	0.00	0.0	0.00	0.0	0.00	0.00
LOW SPAN	—	—	—	—	—	—
MID SPAN	2.0	2.2	2.0	2.3	3.0	1.00
HIGH SPAN	4.0	3.9	-1.0	3.9	-1.0	0.00
BIAS	2.0	—	—	2.2	2.0	—

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
F028	4	4

Client: ONIZUKA AFB

Location: TURBINE #2 EXHAUST

Prepared By	Date	Checked By	Date	Sheet Title
SHB	2/5			CONTINUOUS MONITORING QA/QC

O_2	SPAN VALUE PPMV	PRE-TEST RESPONSE PPMV	PRE-TEST CAL ERROR %F.S.	POST-TEST RESPONSE PPMV	POST-TEST CAL ERROR %F.S.	DRIFT %F.S.
TEST #1						
ZERO	0.00	0.1	0.40	0.0	0.00	-0.40
LOW SPAN	—	—	—	—	—	—
MID SPAN	11.0	11.0	0.00	11.1	0.40	0.40
HIGH SPAN	19.0	19.0	0.00	19.1	0.40	0.40
BIAS	19.0	19.0	0.00	—	—	—
TEST #2						
ZERO	0.00	0.0	0.00	0.0	0.00	0.00
LOW SPAN	—	—	—	—	—	—
MID SPAN	11.0	11.1	0.40	11.1	0.40	0.00
HIGH SPAN	19.0	19.1	0.40	19.1	0.40	0.00
BIAS	19.0	19.0	0.00	—	—	—
TEST #3						
ZERO	0.00	0.0	0.00	0.0	0.00	0.00
LOW SPAN	—	—	—	—	—	—
MID SPAN	11.0	11.1	0.40	11.0	0.00	-0.40
HIGH SPAN	19.0	19.1	0.40	19.1	0.40	0.00
BIAS	19.0	19.0	0.00	19.1	0.40	—

DAILY POWER PLANT OPERATING LOG - *(TURBINE - BOILER)*

ENGINE MFR: SOLAR | MODEL: T-1021S-21 | HP: 1100 | KW: 750
GENERATOR MFR: ELECTRIC MACHINERY | MODEL: BEMAC II | VOLTAGE: 4160 | KW: 750
DATE: 3 DEC 93

ENGINE SERIAL NUMBER 20654

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	BOILER PSI	BOILER P
MDN	460	280					640	830	69	56	136	5	60	12	15
0100	460	180	72	71	74		630	810	69	56	136	5	58	12	15
0200	460	180					630	810	69	56	136	5	58	12	15
0300	450	170					630	810	69	56	136	5	56	12	15
0400	450	170					630	810	69	56	134	5	67	12	15
0500	460	170					640	830	69	56	136	5	60	12	15
0600															
0700	[illegible]	300					660	850	71	56	137	6	59	12	15
0800		300					660	850	71	56	137	6	61	12	15
0900	470	310	75	74	78		670	860	69	56	138	6	63	12	15
1000	[illegible]	[illegible]					680	870	69	56	139	6	66	12	15
1100	460	300					680	880	68	56	140	6	68	12	15
1200	460	300					690	890	68	56	142	6	71	12	15
1300	460	300					680	880	68	56	142	6	71	12	15
1400	460	300					680	870	68	56	143	6	71	12	15
1500	450	[illegible]					650	[illegible]	67	56	143	6	72	12	15
1600	450	[illegible]					690	[illegible]	67	[illegible]	[illegible]	6	72	12	15
1700	460	[illegible]	75	73	74		[illegible]	[illegible]	67	[illegible]	[illegible]	[illegible]	71	[illegible]	[illegible]
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED		OPERATORS	
PREVIOUS TOTAL	124770	MIDS		MIDS	[illegible]
TOTAL TODAY		DAYS		DAYS	DL
TOTAL TO DATE		SWINGS		SWINGS	[illegible]

REMARKS: Blow down [illegible]

TK

PACKAGE NUMBER: #1

ENGINE SERIAL NUMBER 20646

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	BOILER PSI	BOILER P
MDN															
0100															
0200															
0300															
0400															
0500															
0600															
0700	570	60					710	920	73	58	136	5	61	12.5	16
0800	570	60					710	920	73	58	136	5	62	12.5	16
0900	570	60	76	75	76		720	930	73	58	137	5	65	12.5	16
1000	570	60					730	930	73	58	137	5	68	12.5	16
1100	570	60					730	940	73	58	137	5	71	12.5	16
1200	570	60					740	950	72	58	138	5	73	12.5	16
1300	570	60					740	950	72	58	138	5	73	12.5	16
1400	570	60					740	950	72	58	138	5	73	12.5	16
1500	[illegible]	300					740	[illegible]	72	[illegible]	139	5	74	13	16
1600	[illegible]	[illegible]					750	[illegible]	[illegible]	[illegible]	[illegible]	5	74	13	16
1700	570	[illegible]	76	75	76		740	960	[illegible]	[illegible]	[illegible]	[illegible]	74	13	[illegible]
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	151756	MIDS	
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS: 0450 STARTED

Load banking

TG

PACKAGE NUMBER: #2

ENGINE SERIAL NUMBER 20636

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-8	PCD	LOP	LOT	LO P	INLET AIR TEMP	BOILER PSI	BOILER P
MDN	410	290					640	830	68	56	134	4	56	12.5	15
0100	440	290	65	64	66		630	820	68	56	134	4	54	12.5	15
0200	440	290					630	820	68	56	134	4	54	12.5	15
0300	440	290					630	820	68	56	134	4	53	12.5	15
0400	440	290					630	820	68	56	134	4	53	12.5	15
0500	450	300					640	830	68	56	134	4	55	12.5	15
0600															
0700	480	300					680	880	70	56	136	4	55	12.5	16
0800	470	300					680	880	70	56	136	4	56	12.5	16
0900	460	300	68	67	69		680	870	69	56	136	4	58	12.5	16
1000	460	300					680	870	69	56	137	4	59	12.5	16
1100	470	300					680	880	68	56	137	4	61	12.5	16
1200	470	300					680	880	68	56	137	4	65	12.5	16
1300	470	300					680	880	68	56	137	4	66	12.5	16
1400	440	300					670	870	68	56	137	4	66	12.5	16
1500	460	300					[illegible]	870	68	56	137	4	67	13	15
1600	470	300					680	[illegible]	68	56	137	4	67	13	15
1700	460	300	67	68	70		670	880	68	56	136	4	66	13	15
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	147747	MIDS	
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS: Blow down 1240

TK

PACKAGE NUMBER: #4

DAILY POWER PLANT OPERATING LOG - *(TURBINE - BOILER)*

ENGINE MFR	SOLAR	MODEL	T-1021S-21	HP	1100	KW	750	DATE	[illegible]
GENERATOR MFR	ELECTRIC MACHINERY	MODEL	BEMAC II	VOLTAGE	4160	KW	750		

Package #4

ENGINE SERIAL NUMBER: 1106532

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	PSI (BOILER)	P (BOILER)
MDN	500	140					690	830	72	57	129	4	60	12.5	16
0100	500	140	73	74	76		680	830	72	57	129	4	61	12.5	16
0200	500	140					680	830	72	57	129	4	62	12.5	16
0300	500	150					670	830	72	57	129	4	62	12.5	16
0400	500	150					670	830	72	57	126	4	61	12.5	16
0500	500	150					690	840	72	57	129	4	61	12.5	16
0600															
0700	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16
0800	490	100					680	850	72	57	130	4	65	13	16
0900	[illegible]	[illegible]	22	21	22		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]
1000	[illegible]	[illegible]					[illegible]	[illegible]	72	57	131	4	68	13	16
1100	490	200					690	860	71	57	132	4	70	13	16
1200	490	220					700	860	71	57	132	4	72	13	16
1300	490	220					700	860	71	57	132	4	73	13	16
1400	490	220					700	[illegible]	71	57	132	4	74	13	16
1500	490	240					710	860	70	57	133	4	75	13	16
1600	490	218					710	860	71	57	133	4	75	13	16
1700	500	210	74	73	76		710	860	71	57	133	4	74	13	16
1800															
1900															
2000															
2100															
2200															

ENGINE OPERATING HOURS		OIL ADDED		OPERATORS	
PREVIOUS TOTAL	135907	MIDS		MIDS	[illegible]
TOTAL TODAY		DAYS		DAYS	DR
TOTAL TO DATE		SWINGS		SWINGS	[illegible]

REMARKS

PCD [illegible]

T4 [illegible]

PACKAGE NUMBER #4

Package #5

ENGINE SERIAL NUMBER: 26[illegible]

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	PSI (BOILER)	P (BOILER)
MDN	460	260					[illegible]	[illegible]	71	56	126	4	62	12.5	15
0100	460	260	76	76	75		680	830	71	56	126	4	60	12.5	15
0200	460	280					[illegible]	850	71	56	126	4	60	12.5	15
0300	460	280					680	830	71	56	126	4	59	12.5	15
0400	460	280					680	830	71	56	126	4	58	12.5	15
0500	450	280					690	830	71	54	126	4	62	12.5	15
0600															
0700	[illegible]	270					[illegible]	[illegible]	71	56	128	3	60	12.6	15
0800	460	270					680	850	71	56	129	3	61	12.5	15
0900	510	300	81	81	86		[illegible]	870	71	56	130	3	63	12.5	15
1000	510	300					720	890	71	56	131	3	66	12.5	15
1100	510	300					730	910	71	56	131	3	67	12.5	15
1200	510	300					710	920	70	56	132	3	69	12.5	15
1300	510	300					740	920	70	56	132	3	70	12.5	15
1400	510	280					740	920	70	56	132	3	71	12.5	15
1500	510	290					740	900	70	55	133	4	71	12	16
1600	510	290					740	900	71	55	133	4	71	12	16
1700	530	280	78	83	81		740	920	71	55	132	4	70	12	16
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	142995	MIDS	
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS

T6 [illegible]

PACKAGE NUMBER #5

Package #6

ENGINE SERIAL NUMBER: 64522

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	PSI (BOILER)	P (BOILER)
MDN	500	190					680	900	71	59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0100	500	190	77	76	80		670	890	71	59	125	[illegible]	[illegible]	[illegible]	[illegible]
0200	500	190					670	890	71	59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0300	500	200					670	890	71	59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0400	500	200					670	890	71	59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0500	510	200					690	900	71	57	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0600															
0700	490	200					690	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0800	490	200					670	880	71	59	126	[illegible]	58	12.5	11
0900	490	180	75	76	77		680	880	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000	490	180					680	890	71	59	127	5	59	12.6	16
1100	490	170					690	900	70	59	127	5	62	12.5	16
1200	500	170					690	900	70	59	128	5	65	12.5	16
1300	500	170					690	900	70	59	128	5	66	12.6	16
1400	500	180					690	900	70	59	129	5	66	12.5	16
1500	500	150					700	900	70	59	[illegible]	[illegible]	67	12	16
1600	510	200					700	900	71	[illegible]	[illegible]	[illegible]	67	12	[illegible]
1700	500	200	77	76	78		700	900	[illegible]	[illegible]	[illegible]	[illegible]	66	12	16
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	139438	MIDS	
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS

Blew down 3900

T6 [illegible]

PACKAGE NUMBER #6

750 SPTS/DE FORM 34, JAN 92 REPLACES 1004SPSSQ/DE FORM 34, OCT 89, WHICH WILL BE USED.

DAILY POWER PLANT OPERATING LOG - *(TURBINE - BOILER)*

ENGINE MFR	SOLAR	MODEL	T-1021S-21	HP	1100	KW	750	DATE
GENERATOR MFR	ELECTRIC MACHINERY	MODEL	BEMAC II	VOLTAGE	4160	KW	750	3 Dec 93

ENGINE SERIAL NUMBER 20612

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	PSI	P
MDN															
0100															
0200															
0300															
0400															
0500															
0600															
0700															
0800															
0900															
1000															
1100															
1200															
1300															
1400															
1500															
1600															
1700															
1800															
1900															
2000															
2100															
2200															
2300															

TURBINE AND GENERATOR / BOILER

		MIDS		OPERATORS
PREVIOUS TOTAL	134017	MIDS	MIDS	J [illegible]
TOTAL TODAY		DAYS	DAYS	DR
TOTAL TO DATE		SWINGS	SWINGS	[illegible]

REMARKS

PACKAGE NUMBER #7

ENGINE SERIAL NUMBER 20653

TURBINE AND GENERATOR / BOILER

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	PSI	P
MDN															
0100															
0200															
0300															
0400															
0500															
0600															
0700															
0800							[illegible]								
0900	490	200	70	70	72		690	890	62	55	132	2.5	57	11.5	16
1000	500	200					700	[illegible]	[illegible]	[illegible]	138	2.6	60	11.5	16
1100	490	180					710	910	66	55	139	2.5	63	11.5	16
1200	490	180					720	920	66	55	141	2.5	65	11.5	16
1300	490	180					720	920	66	55	141	2.5	66	11.5	16
1400	490	180					720	920	66	55	141	2.5	67	11.5	16
1500	500	170					730	920	[illegible]	55	142	2.5	69	11	16
1600	500	180					720	920	66	55	142	2.5	69	11	16
1700	470	190	67	70	72		720	910	66	55	[illegible]	2.5	67	11	16
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	138395	MIDS	
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS

on line @ 850

PACKAGE NUMBER # 5

ENGINE SERIAL NUMBER 20658

TURBINE AND GENERATOR / BOILER

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	PSI	P
MDN															
0100															
0200															
0300															
0400															
0500															
0600															
0700															
0800															
0900															
1000															
1100															
1200															
1300															
1400															
1500															
1600															
1700															
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	144810	MIDS	
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS

PACKAGE NUMBER #9

750 SPTS/DE FORM 34, JAN 92, REPLACES 1004SPSSQ/DE FORM 34, OCT 89, WHICH WILL BE USED.

DAILY POWER PLANT OPERATING LOG - *(TURBINE - BOILER)*

ENGINE MFR: SOLAR — MODEL: T-1021S-21 — HP: 1100 — KW: 750
GENERATOR MFR: ELECTRIC MACHINERY — MODEL: BEMAC II — VOLTAGE: 4160 — KW: 750
DATE: 3 DEC 93

ENGINE SERIAL NUMBER 20633

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	BOILER PSI	BOILER P
MDN	510	170					700	860	74	57	135	Ø	56	12.5	16
0100	510	170	74	72	70		700	860	70	57	135	Ø	54	12.5	16
0200	510	170					700	860	70	57	135	Ø	54	12.5	16
0300	500	170					700	860	74	57	135	Ø	53	12.5	16
0400	500	170					700	860	76	57	135	Ø	53	12.5	16
0500	510	170					700	870	72	57	135	Ø	55	12.5	16
0600															
0700	500	180					700	870	74	52	136	Ø	54	13	16
0800	500	180					700	870	74	56	136	Ø	55	13	16
0900	500	200	22	23	22		700	870	23	56	137	Ø	56	12	16
1000	500	200					700	880	23	56	138	Ø	58	13	16
1100	500	200					700	880	22	57	138	Ø	63	13	16
1200	500	200					700	880	22	57	139	Ø	65	13	16
1300	500	200					700	890	22	52	139	Ø	66	13	16
1400	490	180					700	890	22	52	139	Ø	66	13	16
1500	[illegible]	170					710	[illegible]	22	57	140	0	66	12	16
1600	[illegible]	[illegible]					710	[illegible]	72	57	140	0	[illegible]	13	[illegible]
[illegible]	[illegible]	[illegible]	73	72	7		710	890	[illegible]	[illegible]	138	0	[illegible]	13	[illegible]
1800															
1800															
2000															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED		OPERATORS	
PREVIOUS TOTAL	151332	MIDS		MIDS	[illegible]
TOTAL TODAY		DAYS		DAYS	D Rose.
TOTAL TO DATE		SWINGS		SWINGS	[illegible]

REMARKS
Blow down [illegible] T/C

PACKAGE NUMBER #10

ENGINE SERIAL NUMBER 110723

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	BOILER PSI	BOILER P
MDN	420	200					640	[illegible]	71	54	135	4	62	12.5	15
0100	420	200	65	64	68		650	[illegible]	71	54	135	4	60	12.5	15
0200	420	200					650	[illegible]	71	56	135	4	60	12.5	14
0300	410	200					610	[illegible]	71	54	135	4	59	12.5	15
0400	410	200					640	[illegible]	71	54	135	4	59	12.5	15
0500	440	200					640	[illegible]	71	54	135	4	61	12.5	15
0600															
0700	440	210					690		71	54	136	4	59	13	15
0800	440	200					690	820	71	54	136	4	60	13	15
0900	410	170	64	63	66		660	[illegible]	70	54	136	4	61	13	15
1000	460	170					670	820	70	54	138	4	65	13	15
1100	460	180					680	810	70	54	140	4	67	13	15
1200	470	180					690	910	70	54	140	4	69	13	15
1300	480	180					700	910	70	54	140	4	70	13	15
1400	510	210					710	920	71	54	140	4	71	13	15
1500	490	210					700	920	71	54	140	4	71	[illegible]	15
1600	490	210					690	[illegible]	70	54	140	4	70	[illegible]	15
1700	[illegible]	190	68				680	920	70	54	140	4	70	[illegible]	15
1800															
1800															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	152177	MIDS	
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS
Unit blowing down [illegible]

PACKAGE NUMBER #11

ENGINE SERIAL NUMBER 20691

TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	BOILER PSI	BOILER P
MDN	440	160					700	830	72	56	130	0	53	12.5	17
0100	440	160	62	62	65		690	830	72	56	130	0	51	12.5	17
0200	440	160					690	830	72	56	130	0	51	12.5	17
0300	440	160					690	830	72	56	130	0	50	12.5	17
0400	440	160					690	830	72	56	130	0	50	12.5	17
0500	450	150					690	830	72	56	130	0	52	12.5	17
0600															
0700	460	160					690	860	72	57	130	1	50	13	18
0800	460	160					690	860	72	57	130	1	51	13	18
0900	420	180	61	61	62		680	850	71	57	131	1	51	13	18
1000	430	180					700	870	71	57	132	1	54	13	18
1100	480	200					720	890	70	57	132	1	57	13	18
1200	480	200					730	900	70	57	133	1	59	13	18
1300	480	200					740	920	70	57	133	1	60	13	18
1400	510	210					760	930	71	57	133	1	61	13	18
1500	500	210					750	[illegible]	70	57	134	0	61	13	18
1600	490	200					740	890	70	57	134	0	60	13	18
1700	470	200	66	68	67		750	[illegible]	70	57	132	0	61	13	18
1800															
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	119270	MIDS	8 GALS #0060
TOTAL TODAY		DAYS	
TOTAL TO DATE		SWINGS	

REMARKS
Blow down [illegible] T3/F

PACKAGE NUMBER #12

PACIFIC ENVIRONMENTAL SERVICES, INC.

Project No.	Page	of
F028	1	1

Client: ONIZUKA AFB

Location: POWER PLANT 12/3/93

Prepared By	Date	Checked By	Date	Sheet Title
SHD	2/5			POWER GENERATION / KW LOG

TIME	#1	#2 ↓	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12
0700	480	570	480	490	460	490	0	0	0	500	440	460
0800	480	570	470	490	460	490	0	0	0	500	440	460
0900	470	570	460	500	510	490	0	490	0	500	410	430
1000	470	570	460	500	510	490	0	500	0	500	460	430
1100	460	570	470	490	510	490	0	490	0	500	460	480
1200	460	570	470	490	510	500	0	490	0	500	470	480
1300	460	570	470	490	510	500	0	490	0	500	480	480
1400	450	570	440	490	510	500	0	490	0	490	510	510
1500	480	565	460	490	500	500	0	500	0	490	490	500
1600	450	540	470	490	500	500	0	500	0	490	490	490
AVG	466	567	465	492	498	498	0	395	0	497	465	472

TOTAL = 4815 KW/HR

GAS METER

0713 → 1553 = 8.67 HRS

X100

(A) 998121 → 999030 = 909 UNITS

(B) 302463 → 303144 = 681 UNITS

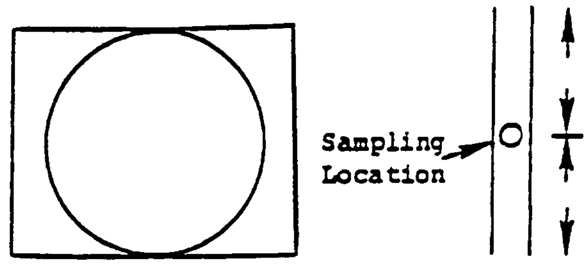
4815 KWH × 8.67 HRS = 41746 KWH

41746 KWH / 909 UNITS = 0.0218 UNITS/KWH

41746 KWH / 681 UNITS = 0.0163 UNITS/KWH

PRELIMINARY VELOCITY TRAVERSE

Plant: ONIZUKA AFB
Date: 1-12-94
Location: TURBINE #2 EXHAUST
Stack I.D.: 24"
Barometric Pressure, in. Hg: 30.22
Stack Gauge Pressure, in. H_2O: -0.1
Operators: BROWN
Pitot Tube I.D. Number: ST4
Temperature Readout I.D.: FISHER/TC-12
Pitot Tube Leak Check: OK



Schematic of Traverse Point Layout

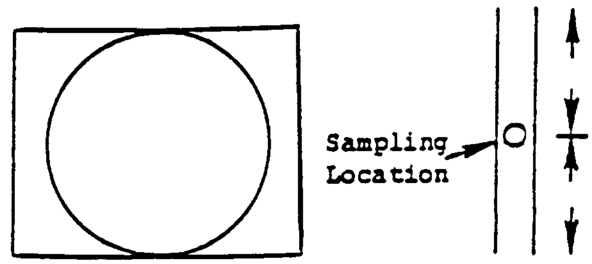
MAGY: CA59

Traverse Point Number	Velocity Head (Δp_g) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
L 1	1.40	450	1.6
2	1.25	451	6.0
3	1.60	438	18.0
4	1.25	434	22.3
		443	
Average			

Traverse Point Number	Velocity Head (Δp_g) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
R1	1.40	444	
2	1.45	450	
3	1.55	449	
4	1.25	444	
		447	
	V		
Average	1.18	445	

PRELIMINARY VELOCITY TRAVERSE

Plant: ONIZUKA AFB
Date: 1-12-94
Location: TURBINE #2 STACK
Stack I.D.: 24"
Barometric Pressure, in. Hg: 30.22
Stack Gauge Pressure, in. H_2O: -0-
Operators: BROWN
Pitot Tube I.D. Number: ST4
Temperature Readout I.D.: FISHER/TC-12
Pitot Tube Leak Check: OK



Schematic of Traverse Point Layout

MAGY = CA59

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
REF.	POINT	L-3	
TEST	#1		
10:55	1.65	440	
11:05	1.65	441	
11:15	1.65	442	
11:25	1.65	441	
11:35	1.65	443	
TEST	#2		
12:19	1.65	444	
12:29	1.65	442	
12:39	1.65	444	
12:49	1.65	445	
12:59	1.65	444	
Average			

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
TEST	#3		
13:38	1.65	444	
13:48	1.65	445	
13:58	1.65	445	
14:08	1.65	444	
14:18	1.65	445	
Average			

HYDROCARBON SAMPLING FIELD DATA

Project No. F028

CLIENT: ONIZUKA AFB **Date:** 1-12-94

Sampling Location: TURBINE #2 EXHAUST

TANK # : / FLOW METER : / Time		108 / 6F99 / Sample A " Hg	"H_2O		117 / MR41 / Sample B " Hg	"H_2O		106 / 6F99 / Sample C " Hg	"H_2O
0	10:56	30.5	0.80	12:18	30.0	0.90	13:38	30.5	0.80
10	11:06	25.0	0.90	12:28	25.2	0.98	13:48	24.8	0.90
20	11:16	18.6	0.88	12:38	20.2	1.0	13:58	19.2	0.90
30	11:26	12.8	0.84	12:48	15.3	1.0	14:08	14.2	0.90
40	11:36	7.5	0.88	12:58	10.2	1.0	14:18	8.7	0.90
POST LEAK-CHECK									
0	12:22	7.6	0.00	13:40	10.4	0.00	14:38	8.5	0.00
10	12:32	7.6	0.00	13:50	10.4	0.00	14:48	8.5	0.00
		OK			OK			OK	
		TEST #1			TEST #2			TEST #3	

Pre Leak-check OK Post Leak-check _____

Plant: ONIZUKA AFB

Date: 1-12-94

Source/Sample Number: TURBINE #2 EXHAUST
RUNS 1,2,3

1. $Vm(std) = (17.64)(Vm)(Y)\left[\frac{P_{bar} + (\Delta H/13.6)}{Tm}\right]$

$Vm(std) = (17.64)(\quad)(\quad)\left[\frac{(\quad) + (\quad /13.6)}{(\quad)}\right]$

Vm(std) = NA dscf.

2. Volume water vapor collected (standard conditions).

V(lo) = ______ condensate from impingers and selica gel.

Vw(std) = (0.04707) V(lo) = (0.04707)( )

Vw(std) = NA scf.

3. Percent moisture, by volume.

$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(\quad)}{(\quad) + (\quad)}$ = 4.6% *

Bw_s = 0.046 .

* FROM PM10 TESTING

4. Molecular weight, stack gas.

Dry molecular weight.

$Md = 0.440(\%\ CO_2) + 0.320(\%\ O_2) + 0.280(\%\ N_2 + \%\ CO)$

Md = 0.440 (2.5) + 0.320(17.5) + 0.280(80.0)

Md = 29.10 lb/lb-mole.

$Ms = Md + Bw_s\ (18 - Md)$ = (29.10) + (0.046)(18 - 29.10)

Ms = 28.59 lb/lb-mole.

Plant: ONIZUKA AFB

Date: 1-12-94

Source/Sample Number: TURBINE #2 EXHAUST

RUNS # 1, 2, 3

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(1.00)(1.18)\left[\sqrt{\frac{(460+445)}{(30.22)(28.59)}}\right] \quad 905$$

Vs(avg) = 103.2 ft/sec.

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

Qs = (60)(Vs)(A) = (60)(103.2)(3.14)

Qs = 19,450 acfm.

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(19,450)(1 - 0.046)\left[\frac{(30.22)}{(905)}\right]$$

Q(std) = 10,930 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1 - Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(\quad)(\quad)}{(\quad)(\quad)(\quad)(\quad)(1 - \quad)}\right]$$

%I = NA %

ENGINE MFR	SOLAR	MODEL	T-1021S-21
GENERATOR MFR	ELECTRIC MACHINERY	MODEL	BEMAC II

ENGINE SERIAL NUMBER 20646

1/12/94

	TURBINE AND GENERATOR													BOILER	
TIME	KW	KVAR	AMPS 1	AMPS 2	AMPS 3	VOLTS	T-7	T-5	PCD	LOP	LOT	LO P	INLET AIR TEMP	PSI	P
MDN															
0100															
0200															
0300															
0400															
0500															
0600															
0700															
0800															
0900	550	-	75	74	75		670	870	73	57	136	5	52	12.5	15
1000	550						680	880	73	57	136	5	56	12.5	15
1100	550						680	880	73	57	136	5	60	12.5	15
1200	c														
1300	550						700	900	72	57	136	5	64	12.5	15
1400	550						700	900	72	57	136	5	66	12.5	15
1500	540						710	905	72	58	136	5	68	12.5	15
1600	540						710	905	72	58	136	5	68	12.5	15
1700															
1800								Secured 1					1745		
1900															
2000															
2100															
2200															
2300															

ENGINE OPERATING HOURS		OIL ADDED	
PREVIOUS TOTAL	152497	MIDS	
TOTAL TODAY	10	DAYS	
TOTAL TO DATE	152507	SWINGS	

REMARKS

PACKAGE NUMBER 2

APPENDIX C

LABORATORY REPORTS AND ANALYTICAL METHODS

REPORT

TRUESDAIL LABORATORIES, INC.

CHEMISTS - MICROBIOLOGISTS - ENGINEERS

RESEARCH — DEVELOPMENT — TESTING

14201 FRANKLIN AVENUE
TUSTIN, CALIF. 92680
AREA CODE 714 • 730-6239
AREA CODE 213 • 225-1564
FAX 714 • 730-6462

CLIENT **PACIFIC ENVIRONMENTAL SERVICES, INC.**
13100 Brooks Drive
Baldwin Park, CA 91706
Attn: S. Hugh Brown

DATE Jan. 18, 1994

RECEIVED Jan. 14, 1994

LABORATORY NO. 53691

SAMPLE 3 tanks from project PES/ONIZUKA AFB

INVESTIGATION

Total hydrocarbon analysis by SCAQMD method 25.2

RESULTS

The submitted samples were analyzed for CH_4, CO, CO_2 and nonmethane hydrocarbons (as C_1) by SCAQMD Method 25.2. Oxygen concentrations were determined by Orsat analysis.

The results obtained are as follows:

PACIFIC ENVIRONMENTAL SERVICES, INC.
LN 53691

SAMPLE	ID	NMVHC $ppmvC_1$	CH_4 ppmv	CO ppmv	CO_2 ppmv	O_2 %v
Test-1	108	ND	7	60	18610	17.9
Test-2	117	11	6	58	18590	18.2
Test-3	106	ND	6	57	18700	18.1
Detection limit		4	2	2	2	0.2

ND = Not detect

TRUESDAIL LABORATORIES, INC.

Prepared by:

Xuan Huong Dang
Analytical Chemist
Air Pollution Testing

Reviewed by:

Charles M. Figueroa
Project Manager
Air Pollution Testing

MAY 11 1992

TRUESDAIL LABORATORIES, INC.

DETERMINATION OF HYDROCARBON EMISSIONS BY TOTAL COMBUSTION ANALYSIS (TCA) METHOD

Table of Contents

Method

This method is based on SCAQMD METHOD 25.1

1.0 Summary of Method

This procedure uses a sampling train comprising a stainless steel probe and a freeze-out trap connected to an evacuated seven-liter tank via a Magnehelic pressure differential gauge. The trap is used for collecting the condensable organic matter while the non-condensable gases are being collected in the tank.

2.0 Equipment list

2.1 7-liter tank with vacuum gauge
2.2 Stainless steel condensate trap and probe
2.3 Magnehelic gauge
2.4 Metal Dewar flask with dry ice
2.5 Tank holder

3.0 Preparation of sampling train

3.1 Determine the number of tanks and traps required, and match only outlet tanks with outlet traps for sampling at an outlet location. Similarly, the principle applies to inlets.

3.2 Using a high-volume vacuum pump, evacuate the 7-liter tanks to a pressure of 1 Torr or less three times, filling the tanks to one atmosphere between evacuations.

3.3 After the third evacuation, turn off the valves and check for leaks by allowing the tanks to stand for at least 16 hours, after which period any leaks will become apparent by a change in the vacuum gauge readings.

3.4 For convenience in transporting as well as ease of handling at the test site, two tanks can be placed in a wooden holder.

3.5 Set up each train in the following sequence: tank, Magnehelic gauge, trap, and probe. Be sure to determine the proper torque required to tighten these crucial connections, as too much torque will spoil the fittings for future conections while too little torque will result in leakage.

3.6 Perform a leak check on each train by introducing nitrogen into the connections at the probe tip. Magnehelic needle will deflect and should return to the same "zero" point after a short while. This signifies a good leak check.

3.7 The assembly is now ready for transport to the test site. It should be noted that triplicate samples are usually taken at the inlet locations and duplicates for outlets.

4.0 Sampling at test site

4.1 Conduct pre-test flow and temperature measurements according to method described in Truesdail Laboratories, Inc. S.O.P. Before the stack traverse, make sure that both the air pollution control unit and the production line is running at the conditions in the test protocol or on the AQMD's "Permit to Construct."

4.2 Immerse the traps into the metal Dewar flask filled with crushed dry ice to a depth of four inches. Maintain the dry ice level for the whole duration of the test.

4.3 Uncap the probe tips and wrap the tips as close as possible to each other in order to satisfy duplicate or triplicate sampling. Avoid touching the tips to prevent contamination.

4.4 Insert the probes into the sampling port carefully so as not to scrape the port walls on the way in. Position the tips near the center of the duct. The port should then be sealed off with duct tape.

4.5 Coordinate all sampling stations, i.e., begin and end the test simultaneously. Integration times will vary from 30 to 120 minutes.

4.6 During the sampling period, record the vacuum gauge reading at 5-minute intervals and make field notes regarding any unusual events which may affect subsequent analytical results. Examples being: (1) the plugging of flow due to a frozen line, and (2) problems associated with the production line.

4.7 Adjust the flow into the tanks such that between 5 to 10 inches of vacuum remain at the end of the sampling period. Close all valves at the end of the test.

4.8 Remove the probes from the duct carefully and cap off the probe tips.

4.9 Perform a post-test leak check by opening the valves. The Magnehelic needle will deflect and will settle down to its original position if there are no leaks. Make a note otherwise.

4.10 Label all tanks and traps accordingly, i.e., include the name of client, sampling date and location, and test and tank number.

4.11 For verification and quality control purposes, conduct a post-test flow and temperature measurement.

4.12 Transport the assemblies to the laboratory for analysis.

4.13 Disconnect the sampling trains and plug the open end of the traps. Store the traps in a dry ice or household freezer until they can be processed.

4.14 Measure the pressure in the tanks with a manometer and add pre-purified dry nitrogen to an absolute pressure of at least 860 Torr.

4.15 Record these pressures as they will be needed for further analytical computations. The corrected barometric pressure and temperature are to be recorded as well.

5.0 Analytical description

This involves the separate determinations of carbon monoxide, methane and carbon dioxide, and the combined determination of $C_2$and higher molecular weight hydrocarbons. Results are reported as parts per million (ppm) and pounds per hour (lb/hr) as carbon.

The gaseous portion and condensables portion are analyzed separately. The analysis of the gaseous portion requires a gas chromatographic column to separate and elute, in order, carbon monoxide, methane and carbon dioxide in the sample. The separated components are then methanized and detected by a flame ionization detector (FID). The amount of methane measured by the FID is recorded on a chromatogram strip chart.

The analysis of the volatile hydrocarbons in the gaseous portion requires a gas chromatographic column preceded by a 7-inch loop of Tenax material placed in an ice bath (0°C) which absorbs the C_3 and higher hydrocarbons. The C_2 hydrocarbons are separated from carbon monoxide, methane and carbon dioxide in the sample (which elute together) by the chromatographic column. After C_2 is eluted, the carrier gas flow direction is reversed and the Tenax loop is heated with boiling water (100°C) to desorb the remaining hydrocarbons. As each component is eluted, it passes through a catalytic oxidizer which converts it to carbon dioxide. Each carbon dioxide peak is measured by a non-dispersive infrared (NDIR) spectrophotometer, utilizing a carbon dioxide detector, and quantified by a computing integrator (GC/NDIR).

The condensable portion of the sample is analyzed for total hydrocarbons as carbon by volatilizing the trap contents and catalytically oxidizing everything to carbon dioxide which is then collected in an evacuated vessel and quantitatively determined by the FID as mentioned in 5.2.

In order to obtain meaningful analytical data, it is necessary to procure accurate reference standards and to calibrate the instruments with these standards at frequent intervals. Known concentrations of carbon monoxide, methane, carbon dioxide and propane in dry nitrogen are purchased from a vendor and are NBS traceable (+/-2%).

6.0 Gaseous sample analysis

6.1 Record the room temperature and barometric pressure.

6.2 After the sample tanks have settled down to room temperature, the absolute pressure is measured with a mercury manometer. The tanks are then pressurized with dry nitrogen to at least 32 inches of mercury (absolute), re-equilibrated, and measured again. The measurements are recorded and a dilution factor calculated.

6.3 The GC/FID instrument is calibrated with a standard gas sample.

6.4 The pressurized sample is used to flush the sample loop on the gas chromatograph with sample and the injection valve actuated to place the loop into the carrier circuit.

6.5 The sample fractions are eluted in order - methane, carbon monoxide, and carbon dioxide - and plotted on a strip chart chromatogram.

6.6 A computer instantaneously integrates and calculates each sample peak with the appropriate constants and correction factors, and reports these values at the end of the chromatogram. Replicate runs are made until ± 5% maximum deviation is obtained.

6.7 The GC/NDIR instrument is standardized with a standard gas sample.

6.8 The pressurized sample is used to flush the sample loop on the gas chromatograph with sample.

6.9 The injection valve is actuated, placing the sample loop into the carrier circuit with the Tenax loop immersed in an ice bath.

6.10 When the C_2 hydrocarbons have been eluted or their retention time passed, the carrier gas flow through the Tenax and GC column is reversed and the Tenax loop immersed in boiling water. The C_3 and higher molecular weight hydrocarbons are eluted together and plotted with the previous peaks on a strip chart chromatogram after detection by the NDIR analyzer.

6.11 A computer instantaneously integrates and calculates each sample peak with the appropriate constants and correction factors and reports these values at the end of the chromatogram. Replicate runs are made until ± 5% maximum deviation is achieved.

6.12 In the event that any of the hydrocarbon peaks are high enough to make the analyzer off scale, the sample is re-analyzed using a smaller loop and an appropriate standard.

7.0 Condensate trap recovery

7.1 Place the trap in a dry ice cooling bath and then heat the ends of the trap with a Bunsen burner to drive the hydrocarbons into the cold section of the trap away from the plugs.

7.2 After a minimum of five minutes in the cooling bath, the plugs are removed from the trap and the trap is then connected to the carrier gas on one end and a 1.8-liter evacuated vessel on the other end. The trap is purged at a rate similar to the sampling rate until at least 1 liter of purged gases are collected for at least six minutes.

7.3 Remove the purge gas vessel. Another evacuated collection vessel is the attached to the NDIR effluent and flow re-established in a push-pull fashion.
The trap is connected to the oxidizer, followed by a sulfuric acid bubbler to remove moisture and a NDIR carbon dioxide analyzer to indicate how much hydrocarbon is left in the trap.

7.4 The cooling bath is removed and the trap is slowly heated with a Bunsen burner until the stainless steel trap reaches a dull red glow and the sample is eluted from the trap as indicated by the NDIR.

7.5 The collection vessel is analyzed for carbon dioxide by GC/FID as in 6.1 thru 6.6.

7.6 The purge gas vessel is analyzed for volatile hydrocarbons by GC/NDIR as in 6.7 thru 6.12.

7.7 For traps where low condensables are expected, especially outlet ones, with the possibility of high moisture and carbon dioxide in the samples, the trap is placed in a water bath at room temperature and connected to a short loop of stainless steel (1/4-inch O.D.) packed with quartz wool and placed in a dry ice bath. The purge step is then performed and the purge loop incorporated into the trap analysis as in 7.3. This alternative procedure will minimize the amount of unpurged stack carbon dioxide which may have dissolved in the trap condensate.

8.0 Calculations

8.1 Condensable hydrocarbons:

(a) Integrate the area of the standard.

(b) Integrate the area of the sample.

(c) Calculate the concentration in ppm of carbon equivalent as follows:

$$C_{smpl} = \frac{C_{std} \times A_{smpl} \times V_{ves} \times \frac{P_{tank}}{29.9} \times \frac{520}{460+T}}{A_{std} \times V_{tank} \times \frac{P_{tank}}{29.9} \times \frac{520}{460+T}}$$

where C_{smpl} = concentration of the sample in ppm,
C_{std} = concentration of the standard in ppm,
A_{smpl} = area of the sample,
A_{std} = area of the standard,
V_{tank} = volume of the sample tank in liter,
V_{ves} = volume of the collection vessel in liter,
P_{tank} = pressure (absolute) of the tank in inches of mercury, and
T = room temperature in ^{o}F.

8.2 Volatile hydrocarbons and gaseous components:

(a) Integrate the area of the standard.

(b) Integrate the area of the standard components.

(c) Calculate the concentration in ppm of carbon equivalent as follows:

$$C_{smpl} = \frac{C_{std} \times A_{smpl} \times \frac{P_B + P_f}{P_B + P_i}}{A_{std}}$$

where P_B = barometric pressure (net) in inches of mercury,
P_i = residual pressure of sample tank, and
P_f = final pressure of sample tank after N_2 addition.

8.3 The following formula is used for the computation of the emission rate in lb/hr carbon:

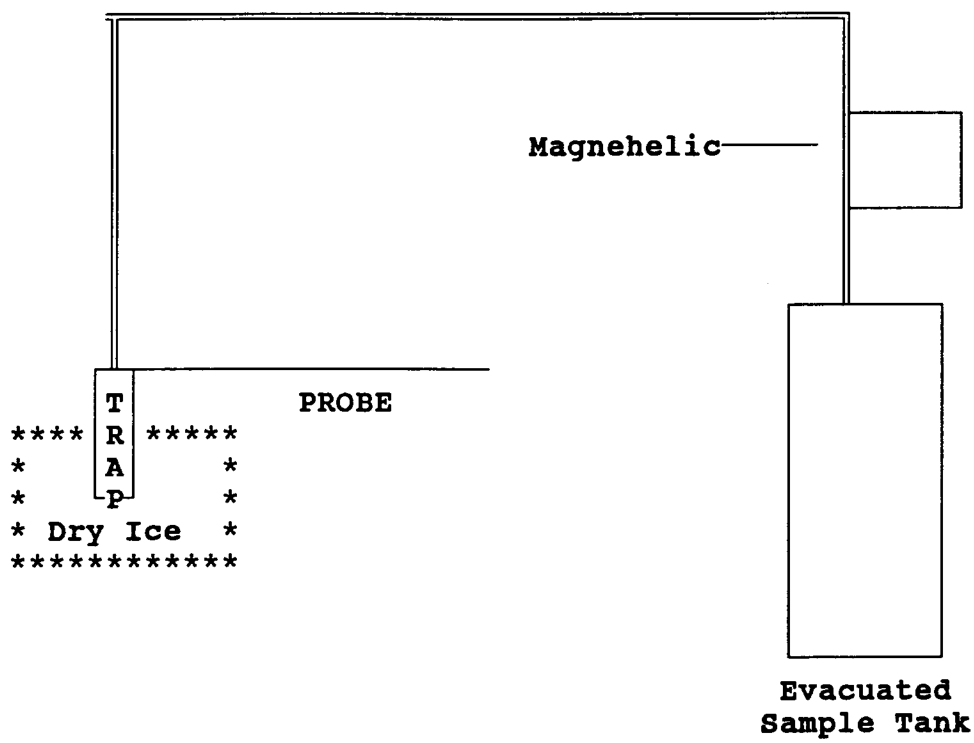
$$\frac{C \times 12\ lb/mole \times Q_{sd}}{3.79 \times 10^8\ ft^3/lb.mole}$$

where C = total concentration of hydrocarbons present in ppm, and
Q_{sd} = flow rate in standard ft^3/hr (dry).

9.0 Diagrams

Diagrams of the assembly is shown on the following page. Note that the distance between the dry ice top surface and the sampling probe of the trap should be at least one inch so that water will not freeze in the narrow sampling tube.

TCA Sampling Train Setup



Revision: Draft
Date: 11/91
Prepared by: XHD
Approved by: PDM
QA Approval: TJP

STANDARD OPERATING PROCEDURE FOR: TOTAL HYDROCARBON ANALYSIS BY SCAQMD 25.1

Table of Contents

STANDARD OPERATING PROCEDURE FOR:
TOTAL HYDROCARBON ANALYSIS BY SCAQMD 25.1

Method
This method is based on SCAQMD METHOD 25.1. It is intended for the determination of total hydrocarbons in source emissions.

1.0 Principle

Samples are collected in two fractions by using an evacuated tank to draw gases through a condensate trap chilled in dry ice. In this modificaton of the method, both fractions are separately analyzed for carbon monoxide, methane and carbon dioxide, in addition to a combined determination of C2 and higher molecular weight hydrocarbons. Results are reported as parts per million (PPM) in the sample, and as pounds of carbon per hour from the source.

Applicability

This method is applicable to determination of stationary source emmisions including incinerators, boilers and absorbers.

2.0 Equipment Required

2.1 GC/FID

2.2 GC/NDIR

2.3 Ice water bath: 1000ml Beaker filled with ice and deionized water.

2.4 Boiling water bath: 1000 ml Beaker filled with deionized water, wire gauze, tripod and Bunsen burner.

2.5 Dry ice.

2.6 Evacuated 1.8 liter vessel.

2.7 Condensate trap

3.0 Reagents Required

See 3.1 and 3.2 of SOP titled TCA 25.2/SOP

4.0 Procedure

This method requires the use of two different instruments, GC/FID and GC/NDIR and Orsat equipment. The samples are collected in two fractions, a gaseous fraction and a condensible fraction. Each fraction must be analyzed separately using both instruments.

4.1 Preparation of Gaseous Fraction of Sample

4.1.1 Record room temperature and barometric pressure.

4.1.2 When the sample has equilibrated to room temperature, measure the absolute pressure in the sample cylinder with a mercury manometer, and record the result as residual vacuum (R.V.).

4.1.3 Pressurize the sample cylinder with ultra-pure nitrogen to at least 6 inches of mercury (absolute), then allow to equilibrate to room temperature (about 5 minutes).

4.1.4 Repeat the measurement of absolute pressure, and record the result as pressure of nitrogen (PN_2).

4.1.5 Calculation for dilution factor (XF) and sample amount (SA)(see 5.1).

4.2 Preparation of Condensable Fraction of Sample

Note: Inlet traps and outlet traps differ substantially in the level of hydrocarbons present, and so require slightly different handling. Several of the steps below will contain alternative instructions for onlet and outlet traps. Inlet traps and outlet traps are kept separate; inlet traps are not used to sample outlets, and vice versa in order to avoid sample carry-over problems.

4.2.1 Evacuate two 2 liter tanks to -30" Hg. Prepare a solution of 0.1N H_2SO_2 for the knock-out which is connected between the catalyst and the NDIR. The water knock-out also requires an ice bath.

4.2.2 Determine the baseline for the NDIR. On range 3, the baseline will usually be between 10 and 15 at room temperature.

4.2.3 Remove the trap from the freezer. Inlet traps: immerse the trap in a dry ice bath, connect one side of the trap to the carrier gas, and the other to an evacuated tank. Outlet traps: connect one side of the trap to the carrier gas, and the other side to a cold finger which is immersed in a dry ice bath (the trap itself is allowed to warm to room temperature). The other side of the cold finger is connected to an evacuted tank.

4.2.4 Start the carrier gas flowing through the trap for 5 minutes, until the pressure the pressure in the tank is about -10" Hg. This tank is then analyzed and added to the sample collected in the trap.

4.2.5 Connect the trap to the catalyst column. Attach a second evacuated cylinder to the outlet of the NDIR. If a inlet is being burned, use an eight liter cylinder. If an inlet is being burned, use a two liter flask. Perform a leak check by turning on the carrier gas flow briefly. Watch the bubbles in the water knock-out. When the bubbles stop with the system pressurized and the carrier gas is turned off,there should be a complete equlibrium in the drop-out. The presence of water moving backwards in the drop-out signifies a leak in the trap or catylist. If bubbles continue to flow, there is a leak in the NDIR or tank connection.

4.2.6 Start the carrier gas flow, remove the dry ice bath and begin heating the trap with the burners. For inlet traps, set the supplemental oxygen flow to match the carrier gas flow. For outlet traps, burn the cold finger along with the trap: supplemental oxygen is not needed in most cases. Observe the reading on the NDIR. It should quickly begin to rise.

4.2.7 Continue burning the trap until the NDIR reading falls to near the blank value. The trap is allowed to cool to room temperature, and then is briefly heated again to determine whether all the condensable hydrocarbons have been driven off. If the NDIR reading does not increase during this final check the trap is clean. It is important that hydrocarbons will condense in the tubing and that it must be burned out with the trap. Also any place there is a connector, it must be heated to make sure that the inside is cleaned.

4.2.8 The tank from the burn and the purge are pressurized and analyzed (see above for gas sample portion).

4.3 GC/FID Analysis of Samples

4.3.1 Check carrier gas (UP He), if low, change the gas tank.

4.3.2 Change the output from "test" to "1", change the range from "Bal" to "10".

4.3.3 Increase He to 50 psi.

4.3.4 Turn on H_2 to 30 psi.

4.3.5 Ignite the FID.

4.3.6 Turn on Air to 20 psi.

4.3.7 Increase He to 80 psi.

4.3.8 Turn FID Zero Suppression on, and switch detector Output from "1" to "2".

4.3.9 Let the instrument warm up for 20 minutes.

4.3.10 Start the Maxima program of the Dynamic Solutions system, and set up the automatic data acquisition according to the manual Maxima 820.

4.3.11 Standard Calibration - Calibration standards are commercial stock standard mixtures made from certified gas company.

(a) Inject a standard sample through a sample loop on the GC.

(b) Press "Run" on the GC to place the loop into the carrier gas circuit.

(c) The calibration standards are run in replicate until +/- 2% maximum deviation is obtained.

4.3.12 The sample is injected in the same manner as the standard, steps 4.3.11: a, b, and c.

4.4 GC/NDIR Analysis of Samples

4.4.1 Turn on the instrument and allow the GC oven to reach analysis temperature (approximately about 800 F).

4.4.2 Start Nitrogen flow.

4.4.3 Turn on the integrator: change the RANGE from "Tune" to "1", set GAIN from "0" to "5".

4.4.4 When the GC oven reaches 800 F, turn the ZERO tune all the way to the right, and then adjust the SOURCE BALABCE until it reads between 35-40.

4.4.5 Adjust the ZERO tune until the display reads "2" by turning it to the left.

4.4.6 Equilibrate the Tenax loop in the ice water bath.

4.4.7 Run a blank sample to check for carry-over prior to running standard.

4.4.8 Standard Calibration - Calibration standards are commercial stock standard from certified gas company.

(a) Flush the sample loop with the pressurized standard, then switch the injection valve to inject the sample.

(b) Press "Start" on the integrator.

(c) When the C_2 has been eluted or their expected retention time has passed, the carrier gas flow direction is reversed, and the Tenax loop is immersed in boiling water to desorb the remaining hydrocarbons.

(d) The calibration standards are repeated until +/- 5% maximum deviation is obtained.

4.4.9 Inject the sample in the same manner as the standard, steps 4.4.8: a, b, and c

4.4.10 Repeat the analysis of samples until +/-5% maximum deviation is obtained. If any of the hydrocarbons peaks are off scale, recalibrate the GC using a new standard that is closer to the concentration of the sample and then reanalyze the sample.

4.5 Dilution

See 4.5 of the SOP titled TCA 25.2

4.6 Orsat analysis of samples

See SOP titled 7.1

5.0 Calculations

5.1 Condensable Hydrocarbons

5.1.1 The intergrated area for the standard and the sample are available directly from the chart recorder.

5.1.2 Calculate the concentration in ppm of carbon equivalent as follows:

$$C_{smpl} = \frac{C_{std} \times A_{smpl} \times V_{ves} \times \frac{P_{tank}}{29.9} \times \frac{520}{460+T}}{A_{std} \times V_{tank} \times \frac{P_{tank}}{29.9} \times \frac{520}{460+T}}$$

where
C_{smpl} = concentration of the sample in ppm,
C_{std} = concentration of the standard in ppm,
A_{smpl} = area of the sample,
A_{std} = area of the standard,
V_{tank} = volume of the sample tank in liter,
V_{ves} = volume of the collection vessel in liter,
P_{tank} = pressure (absolute) of the tank in inches of mercury,
T = room temperature in F.

5.2 Volatile hydrocarbons and gaseous components

5.2.1 The integrated area for the standard and the sample are available directly from the chart recorder.

5.2.2 Calculate the concentration in ppm of carbon equivalent as follows:

$$C_{smpl}=\frac{C_{std}\times A_{smpl}\times\frac{(P_B+P_f)}{(P_B+P_i)}}{A_{std}}$$

where:
P_B = barometric pressure (net) in inches of mercury,
P_i = residual pressure of sample tank,
P_f = final pressure of sample tank after N2 addition.

The following formula is used for the computation of the emission rate in lb/hr carbon:

$$\frac{C\times 12\,lb/mole\times Q_{sd}}{3.79\times 10^{8}\,ft^{3}/lb.mole}$$

where:

C = total concentration of hydrocarbons present in ppm,
Q_{sd} = flow rate in standard cubic feet per hour (dry).

APPENDIX D

CALIBRATION DATA

Scott Specialty Gases, Inc.

2600 CAJON BOULEVARD, SAN BERNARDINO, CA 92411 (909) 887-2571 FAX (909) 887-0549

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS RECERTIFICATION

Customer
PACIFIC ENVIRONMENT SER
ATTN: STEVE HERNANDEZ
13100 BROOKS DRIVE
BALDWIN PARK CA91706

Assay Laboratory
Scott Specialty Gases
2600 Cajon Boulevard
San Bernardino, CA 92411

Purchase Order 0640-102
Scott Project # 25837.001

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number ALM027046
Cylinder Pressure 2000PSIG

Certification Date 12-23-93
Previous Certification Dates 05-20-93

Acid Rain Exp.
General Exp. 12-23-95

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
NITRIC OXIDE	43.83PPM	±1% NIST Traceable
NOX	44.17PPM	

Balance Gas: Nitrogen

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
GMIS	09-94	ALM033883	100.4PPM

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
TECO / 10AR-38644-258	10-29-93	Chemi-Luminescent

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: NITRIC OXIDE

Previous Certification

Date: 05-20-93 Response Units: mv
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl. 43.83PPM

Third Triad Analysis

Date: 12-23-93 Response Units: mv
Z1= 0.00 R1= 97.0 T1= 41.8
R2= 97.0 Z2= 0.00 T2= 41.8
Z3= 0.00 T3= 41.8 R3= 97.0
Avg. Conc. of Cust Cyl. 43.83PPM

Calibration Curve

Concentration= Ax + B
A =1.0083945
B =-0.139473

Date: Response Units:
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Date: Response Units:
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Concentration=

Date: Response Units:
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Date: Response Units:
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Concentration=

SPECIAL NOTES: IF THIS PRODUCT IS USED FOR ACID RAIN COMPLIANCE, THE ACID RAIN DATE NOTED ABOVE APPLIES PER 40 CFT PART 75, APPENDIX H. OTHERWISE THE GENERAL EXPIRATION DATE APLLIES.

Analyst

Scott Specialty Gases, Inc.

2600 CAJON BOULEVARD, SAN BERNARDINO, CA 92411 (909) 887-2571 FAX: (909) 887-0549

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer:
Pacific Environmental Services
13100 Brooks Drive
Baldwin Park , CA 91706-0740

Assay Laboratory
Scott Specialty Gases
2600 Cajon Boulevard
San Bernardino, CA 92411

Purchase Order 0640-102
Scott Project # 24700

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number ALM027851 **Certification Date** 03-17-93 **Expiration Date** 09-13-94
Cylinder Pressure 1950 psig **Previous Certification Dates** NONE

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
NItric Oxide	22.51 ppm	± 1 % NIST Traceable
NOX	22.82 ppm	

Balance Gas: Nitrogen

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
SRM 2629A	09-93	FF28519	19.3 ppm

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
TECO / 10AR / 14853-150	1-20-93	Chemi-Luminescent

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: Nitric Oxide

First Triad Analysis

Date: 03-01-93 Response Units: mv

Z1= 0.000	R1= 78.33	T1= 90.95
R2= 78.30	Z2= 0.000	T2= 90.92
Z3= 0.000	T3= 90.94	R3= 78.28

Avg. Conc. of Cust Cyl. 22.41 ppm

Second Triad Analysis

Date: 03-17-93 Response Units: mv

Z1= 0.000	R1= 77.12	T1= 90.20
R2= 77.24	Z2= 0.000	T2= 90.54
Z3= 0.000	T3= 90.50	R3= 77.21

Avg. Conc. of Cust Cyl. 22.60 ppm

Calibration Curve

Concentration= Ax^2+Bx+C
A =-0.000504296
B =1.0489880
C =-0.292506

Date: Response Units: mv
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Date: Response Units: mv
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Concentration=

Date: Response Units:
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Date: Response Units:
Z1= R1= T1=
R2= Z2= T2=
Z3= T3= R3=
Avg. Conc. of Cust Cyl.

Concentration=

Special Notes

Analyst Joseph De La Torre

Scott Specialty Gases, Inc.

2600 CAJON BOULEVARD, SAN BERNARDINO, CA 92411 (909) 887-2571 FAX: (909) 887-0549

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer	Assay Laboratory	
PACIFIC ENVIRONMENTAL SER.	Scott Specialty Gases	**Purchase Order** 0640-102
PO# 0640-102	2600 Cajon Boulevard	**Project #** 27964.001
13100 BROOKS AVE	San Bernardino, CA 92411	
BALDWIN PARK, CA 91706		

ANALYTICAL INFORMATION

Certified to exceed the minimum specifications of EPA Protocol 1 Procedure #G1, Section Number 3.0.4

Cylinder Number ALM034155 **Certification Date** 10-06-93 **GENERAL Date** 10-06-95
Cylinder Pressure 1900 psig ACID RAIN DATE

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
NITRIC OXIDE	22.90 PPM	± 1 % NIST Traceable

Balance Gas: Nitrogen

NOX	23.46 PPM

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
GMIS	01-94	ALM033911	24.97 ppm

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
TECO / 10AR / 38644-258	07-26-93	Chemi-Luminescent

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: Nitric Oxide

First Triad Analysis

Date: 09-29-93 Response Units: mv

Z1= 0.00	R1= 96.4	T1= 88.5
R2= 96.4	Z2= 0.00	T2= 88.5
Z3= 0.00	T3= 88.5	R3= 96.4

Avg. Conc. of Cust Cyl. 22.91 ppm

Second Triad Analysis

Date: 10-06-93 Response Units: mv

Z1= 0.00	R1= 96.4	T1= 88.4
R2= 96.4	Z2= 0.00	T2= 88.3
Z3= 0.00	T3= 88.3	R3= 96.4

Avg. Conc. of Cust Cyl. 22.88 ppm

Calibration Curve

Concentration= Ax + B
A =1.001
B =0.05283

Date: Response Units: mv

Z1=	R1=	T1=
R2=	Z2=	T2=
Z3=	T3=	R3=

Avg. Conc. of Cust Cyl.

Date: Response Units: mv

Z1=	R1=	T1=
R2=	Z2=	T2=
Z3=	T3=	R3=

Avg. Conc. of Cust Cyl.

Concentration=

Date: Response Units: mv

Z1=	R1=	T1=
R2=	Z2=	T2=
Z3=	T3=	R3=

Avg. Conc. of Cust Cyl.

Date: Response Units: mv

Z1=	R1=	T1=
R2=	Z2=	T2=
Z3=	T3=	R3=

Avg. Conc. of Cust Cyl.

Concentration=

SPECIAL NOTES: IF THIS PRODUCT IS USED FOR ACID RAIN COMPLIANCE, THE ACID RAIN EXPIRATION DATE NOTED ABOVE APPLIES PER 40 CFT PART 75, APPENDIX H. OTHERWISE THE GENERAL EXPIRATION DATE APPLIES.

ANALYST Thomas E. Wilson

X

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD.
SAN BERNARDINO CA 92411
Phone: 909-887-2571 Fax: 909-887-0549

C E R T I F I C A T E   O F   A N A L Y S I S

PACIFIC ENVIRONMENTAL SER
PO# 0640-102
13100 BROOKS DRIVE

BALDWIN PARK CA 91706

PROJECT #: 02-28622-001
PO#: 0640-102
ITEM #: 02024520 4AL
DATE:11/11/93

CYLINDER #: ALM035757 ANALYTICAL ACCURACY: +/-1%NIST
FILL PRESSURE: 2000PSIG
BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
CARBON DIOXIDE	11.	PCT	11.09	PCT
CARBON MONOXIDE	50.	PPM	50.11	PPM
OXYGEN	11.	PCT	11.00	PCT
NITROGEN		BAL		BAL

2000PSIG BIN#2 11-12-93
CRM1675 14.08%C02 ALM001136
CRM1678 47.2PPM AAL5970 CO
CRM2659 20.63% ALM017555 02

ANALYST:

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD.
SAN BERNARDINO CA 92411
Phone: 909-887-2571 Fax: 909-887-0549

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL SER
STEVE HERNANDEZ
13100 BROOKS DRIVE

BALDWIN PARK CA 91706

PROJECT #: 02-27898-001
PO#: 0640-102
ITEM #: 02024520 2AL
DATE:10/01/93

CYLINDER #: ALM036879 ANALYTICAL ACCURACY: +-1%
FILL PRESSURE: 2000 PSIG
BLEND TYPE : ACUBLEND MASTER GAS

COMPONENT	REQUESTED GAS CONC	MOLES	ANALYSIS (MOLES)	
CARBON DIOXIDE	18.	PCT	18.00	PCT
CARBON MONOXIDE	75.	PPM	75.00	PPM
OXYGEN	19.	PCT	19.00	PCT
NITROGEN		BAL		BAL

CERTIFIED

2000 PSIG BIN#2 10-08-93 CRM1675 ALM001136 CO2,
CRM1679 ALM10524 CO CRM2659 ALM017555 O2

ANALYST:

X

Scott Specialty Gases, Inc.

Shipped From: 2600 CAJON BLVD.
SAN BERNARDINO CA 92411
Phone: 909-887-2571 Fax: 909-887-0549

CERTIFICATE OF ANALYSIS

PACIFIC ENVIRONMENTAL
STEVE HERNANDEZ
C/O FEDERAL EXPRESS
520 LAWERNCE EXPRESS WAY
SUNNYVALE CA 94086

PROJECT #: 02-28936-001
PO#: F028-000
ITEM #: 02022913 4AL
DATE: 12/02/93

CYLINDER #: ALM010841 ANALYTICAL ACCURACY: +/-1%NIST
FILL PRESSURE: 2000 PSIG
BLEND TYPE : CERTIFIED MASTER GAS

COMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
NITRIC OXIDE	10.	PPM	10.36	PPM
NITROGEN - OXYGEN FREE		BAL		BAL
NOX			10.39	PPM

2000 PSIG BIN #1 12-01
GRAVIMETRIC MASTER GAS
AGAINST NIST CERTIFIED WEIGHT
INDEPENDENT LABORATORY

CERTIFIED TO HAVE BEEN BLENDED AND VERIFIED TO BE CORRECT BY ANALYSIS.

ANALYST:

EVER READY THERMOMETER CO., INC.
401 PARK AVENUE SOUTH
NEW YORK, NY 10016

R E P O R T   O F   C A L I B R A T I O N

LIQUID-IN-GLASS-THERMOMETER

CALIBRATED BY EVER READY THERMOMETER CO.

MARKED: ERTCO 611-3FC S/N-2269
RANGE: -20 TO +110 DEGREES C IN 1 DEGREE GRADUATIONS.

THERMOMETER READING	CORRECTION (ITS-90)**
0.0 C	0.0 C
37.0	-0.1
56.0	0.0

** ALL TEMPERATURES IN THIS REPORT ARE BASED ON THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90) PUBLISHED IN THE METROLGIA 27, NO. 1, 3/10/90.

THIS THERMOMETER WAS CALIBRATED AGAINST A STANDARD CALIBRATED AT THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) FORMERLY THE NATIONAL BUREAU OF STANDARDS (NBS).

FOR A DISCUSION OF ACCURACIES ATTAINABLE WITH SUCH THERMOMETERS SEE NBS MONOGRAPH 150.

IF NO SIGN IS GIVEN ON THE CORRECTION, THE TRUE TEMPERATURE IS HIGHER THAN THE INDICATED TEMPERATURE; IF THE SIGN GIVEN IS NEGATIVE, THE TRUE TEMPERATURE IS LOWER THAN THE INDICATED TEMPERATURE. TO USE THE CORRECTIONS PROPERLY, REFERENCE SHOULD BE MADE TO THE NOTES GIVEN BELOW.

THE THERMOMETER WAS TESTED IN A LARGE, CLOSED-TOP, ELECTRICALLY HEATED, LIQUID BATH, BEING "IMMERSED" 76MM. THE TEMPERATURE OF THE ROOM WAS ABOUT 25 DEGREES C (77 DEGREES F). IF THE THERMOMETER IS USED UNDER CONDITIONS WHICH WOULD CAUSE THE AVERAGE TEMPERATURE OF THE EMERGENT LIQUID COLUMN TO DIFFER MARKEDLY FROM THAT PREVAILING IN THE TEST, APPRECIABLE DIFFERENCES IN THE INDICATIONS OF THE THERMOMETER WOULD RESULT.

THE TABULATED CORRECTIONS APPLY PROVIDED THE ICE POINT READING IS 0.0 DEGREES C. IF THE ICE-POINT READING IS FOUND TO BE HIGHER (OR LOWER) THAN STATED, ALL OTHER READINGS WILL BE HIGHER (OR LOWER) TO THE SAME EXTENT.

TEST NUMBER: 140381
DATE: 06/21/90
STANDARD SERIAL NO. 128239
NIST IDENTIFICATION NO. 88024

EVER READY THERMOMETER CO.

METER BOX TEMPERATURE READOUT CALIBRATION

CALIBRATED BY: Robert Nguyen

DATE: 06-16-93

	Inlet (°F)	Outlet (°F)	Thermometer (°F)
BOX 1A	32	32	32 (0 °C)
	77	76	77 (25 °C)
	212	211	212 (100 °C)
BOX 2A	32	32	32 (0 °C)
	76	76	77 (25 °C)
	213	213	212 (100 °C)
BOX 3A	28	27	32 (0 °C)
	75	75	77 (25 °C)
	213	213	212 (100 °C)

NOTE:
Thermometer Standard Serial Number: 128239
Thermometer NIST I.D. Number: 88024

THERMOCOUPLE CALIBRATION

CALIBRATED BY: Robert Nguyen

DATE: 06-16-93

Thermocouple number	Thermocouple reading (°C)	Thermometer reading (°C)
TC-1	0.0 26.5 100.0	0.0 26.5 100.0
TC-2	OUT OF SERVICE	
TC-3	0.0 27.5 99.0	0.0 26.5 100.0
TC-4	OUT OF SERVICE	
TC-5	0.0 26.6 99.0	0.0 26.5 100.0
TC-6	0.0 26.5 100.0	0.0 26.0 100.0
TC-7	0.0 26.2 100.0	0.0 26.0 100.0
TC-8	0.0 26.3 100.0	0.0 26.0 100.0
TC-9	0.0 26.6 100.0	0.0 26.0 100.0

TC-10	0.0 26.3 100.0	0.0 26.0 100.0
TC-11	0.0 26.0 100.0	0.0 26.0 100.0
TC-12	0.0 26.0 100.5	0.0 25.0 100.0
C-1	NOT AVAILABLE	
C-2	NOT AVAILABLE	
S-1A	0.0 25.8 99.0	0.0 26.0 100.0
S-2A	0.0 25.5 99.0	0.0 26.0 100.0
S-16A	0.0 25.7 99.0	0.0 26.0 100.0
S-17A	0.0 25.9 99.0	0.0 26.0 100.0

Thermometer Standard Serial Number: 128239
Thermometer NIST I.D. Number: 88024

DIGITAL THERMOMETER CALIBRATION

CALIBRATTED BY: Robert Nguyen

DATE: 06-16-93

Digital Thermometer	(°F)	Thermometer (°C)
Fisher	32.0	0.0 (32 °F)
	80.0	26.5 (80 °F)
	210.0	99.0 (210 °F)

Digital Thermometer	(°C)	Thermometer (°C)
Omega	1.0	0.0
	26.0	26.5
	98.0	98.0

Digital Thermometer	(°C)	Thermometer (°C)
Fluke (T1)	1.0	0.0
	27.5	26.5
	99.0	98.0

Digital Thermometer	(°C)	Thermometer (°C)
Fluke (T2)	1.1	0.0
	27.4	28.0
	99.0	98.0

NOTE:
Thermometer Standard Serial Number: 128239
Thermometer NIST I.D. 88024

DATE: 3-31-93 OPERATOR: [illegible signature]

DRY GAS METER IDENTIFICATION: Model S-190 25507 WTM IDENTIFICATION: American Meter Co. AL-20 10103

BAROMETRIC PRESSURE (P_b): 29.55 in. Hg

(Note: Pb was falling during calibration)

PACIFIC ENVIRONMENTAL SERVICES, INC.

APPROXIMATE FLOW RATE (Q) cfm		WET TEST METER GAS VOLUME (V_S) ft³	DRY GAS METER VOLUME (V_{dg}) ft³	TEMPERATURES: WET TEST METER (T_s) °F	TEMPERATURES: DRY GAS METER: INLET (T_i) °F	TEMPERATURES: DRY GAS METER: OUTLET (T_o) °F	TEMPERATURES: DRY GAS METER: AVERAGE ($\bar{T}_d$) °F	DRY GAS METER PRESSURE (ΔP) in H_2O	TIME (θ) min.	FLOW RATE (Q) cfm	METER METER COEFFICIENT (Y_{dg})	AVERAGE METER COEFFICIENT ($\bar{Y}_{dg}$)
0.40	A	0.000 5.420	284.603 290.028	74 74	—	77.1 77.4	77	-1.35 -1.35	13.0	0.407	1.008	
	B	0.000 5.392	290.028 295.427	74 74	—	77.4 77.4	77	-1.35 -1.35	13.0	0.405	1.008	
	C	0.000 5.392	295.575 300.968	74 74	—	77.4 77.4	77	-1.35 -1.35	13.0	0.405	1.009	1.008
0.60	A	0.000 7.440	301.605 309.058	74 74	—	77.4 77.4	77	-2.35 -2.35	12.0	0.606	1.010	
Pb = 29.48	→ B	0.000 7.425	309.187 316.639	74 74	—	77.4 77.4	77	-2.35 -2.35	12.0	0.603	1.009	
	C	0.000 7.435	316.689 324.140	74 74	—	77.4 78.2	78	-2.35 -2.35	12.0	0.604	1.012	1.010
0.80	A	0.000 10.122	325.721 335.912	74 74	—	78.2 78.2	78	-3.65 -3.65	12.0	0.822	1.010	
Pb = 29.46	→ B	0.000 10.130	335.979 346.174	74 74	—	78.2 78.2	78	-3.65 -3.65	12.0	0.822	1.010	
	C	0.000 10.167	346.279 356.529	74 74	—	78.2 78.2	78	-3.65 -3.65	12.0	0.825	1.009	1.010
1.00	A	0.000 10.356	357.931 368.410	74 74	—	78.2 78.2	78	-5.15 -5.15	10.0	1.008	1.009	
	B	0.000 10.338	369.142 379.598	74 74	—	78.2 78.2	78	-5.15 -5.15	10.0	1.007	1.009	
	C	0.000 10.325	379.788 390.237	74 74	—	78.2 78.2	78	-5.15 -5.15	10.0	1.005	1.009	1.009
1.20	A	0.000 11.122	391.437 402.758	74 74	—	78.2 78.2	78	-7.10 -7.10	9.0	1.203	1.008	
	B	0.000 11.132	402.922 414.258	74 74	—	78.2 78.2	78	-7.10 -7.10	9.0	1.204	1.007	
	C	0.000 11.100	414.306 425.608	74 74	—	78.4 78.4	78	-7.10 -7.10	9.0	1.201	1.007	1.007

$$Q = 17.65 \frac{V_s}{\theta} \frac{P_b}{(T_s+460)} \qquad Y_{ds} = \frac{V_s}{V_{dg}} \times \frac{(\bar{T}_d+460)}{(T_s+460)} \times \frac{P_b}{\left(P_b + \frac{\Delta P}{13.6}\right)}$$

DRY GAS METER AND ORIFICE CALIBRATION

Dry Gas Meter No. 1557640 Meter Box No. 3A Reference Dry Gas Meter No. 25507 Rockwell

Barometric Pressure 29.8 Calibration Date 12-28-93 Calibrated by: Inga Melv

Orifice Manometer Setting H="H2O	Initial Reference DGM Reading V=ft3	Final Reference DGM Reading V=ft3	Reference Gas Volume Vr=ft3	Initial DGM Reading V=ft3	Final DGM Reading V=ft3	Test DGM Volume Vd=ft3	Temperature Reference DGM tr=F	Temperature Box DGM Inlet t=F	Temperature Box DGM Outlet t=F	Box DGM Average td	Run Time Min.	Flow Rate Q=cfm	Meter Gamma	Delta H@
0.5	761.348	771.359	10.011	698.576	708.743	10.167	76	86	82	84	25.6	0.38	0.998	1.837
1.0	771.657	781.789	10.132	709.045	719.423	10.378	76	92	82	87	18.7	0.53	0.994	1.903
2.0	782.267	792.290	10.023	719.945	730.205	10.260	74	97	85	91	13.4	0.74	1.003	1.968
4.0	792.980	802.990	10.01	730.982	741.358	10.376	74	101	87	94	9.4	1.05	0.991	1.931

AVERAGE	0.997	1.910

MAGNEHELIC CALIBRATION CHECK

UNIT	LOW Mag	LOW Man	MED Mag	MED Man	HIGH Mag	HIGH Man
05-24-93						
JW16 (0-1")	0.10	0.10	0.47	0.47	0.90	0.90
GF17 (0-0.5")	0.060	0.060	0.260	0.260	0.470	0.485
CA59 (0-4")	0.50	0.50	1.70	1.70	3.50	3.50
07-30-93						
R15E (0-1")	0.12	0.12	0.49	0.49	0.82	0.82
JW16 (0-1")	0.12	0.12	0.50	0.50	0.82	0.82
GF17 (0-0.5")	0.065	0.060	0.260	0.260	0.430	0.420
CA59 (0-4")	0.40	0.38	1.90	1.90	3.40	3.40
11-26-93						
R15E (0-1")	0.11	0.10	0.51	0.51	0.87	0.87
JW16 (0-1")	0.10	0.10	0.51	0.51	0.89	0.89
GF17 (0-0.5")	0.050	0.045	0.250	0.250	0.430	0.440
CA59 (0-4")	0.51	0.49	2.02	2.00	3.65	3.65

Readings in " H_2O

Reference: Oil Manometer - Dwyer #400-10
0-1" inclined, 1-10" vertical

PRECISION
INSTRUMENT
REPAIR

PRECISION INSTRUMENT REPAIR CO.

13414 WOODRUFF AVE., BELLFLOWER, CA. 90706

310 /925-6672

REPORT NO: 3916

Certification Report Of Precision Balances and Scales

This is to certify that the balance calibrated is in compliance to US GOVERNMENT MILITARY BOOKLET, MIL-STD-45662A and that the standards used meet the compliance of NIST (NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY)

PRODUCT ORIGINAL CONDITION: **In working order.**

X CALIBRATED AT IN-USE LOCATION ___ CALIBRATED AT P.I.R. OFFICE.

TEMPERATURE: 70°F HUMIDITY: 59% STANDARD USED: **Class I** S/N **5943**

MANUFACTURER, MODEL, SERIAL NUMBER OF PRODUCT CALIBRATED

1 TORSION TORBAL EA-1 ANALYTICAL BALANCE, S/N 156636

Calibrated to: 100mg=100.0mg
Linearity: OK
Maximum Load: OK
Repeteability: OK

COMPANY OR PRODUCT OWNER:

PACIFIC ENVIRONMENTAL SERVICES
13100 BROOKS, SUITE 100
BALDWIN PARK, CA. 91706
ATTN: SIYA
PO# 0640-102

TB

Date of Calibration **12-21-93** Technichian Tom Benson License 1-0903

HYDROCARBON CYLINDERS
VOLUME CALIBRATION
08-20-90

Cylinder #	Full, lbs	Tare, lbs	Net, lbs	Volume, L
101	31.33	4.45	26.88	**12.22**
102	32.65	5.83	26.82	**12.19**
103	31.60	4.69	26.91	**12.23**
104	31.65	4.68	26.97	**12.26**
105	31.42	4.47	26.95	**12.25**
106	32.62	5.82	26.80	**12.18**
107	31.14	4.50	26.64	**12.11**
108	32.45	5.98	26.47	**12.03**
109	31.22	4.69	26.53	**12.06**
110	31.15	4.68	26.47	**12.03**
Supplemental Set 07-29-92				
111	31.42	4.86	26.56	**12.07**
112	32.44	5.86	26.58	**12.08**
113	32.44	5.96	26.48	**12.03**
114	31.50	4.48	27.02	**12.28**
115	32.45	5.90	26.55	**12.06**
116	31.55	4.45	27.10	**12.31**
117	31.35	4.71	26.64	**12.10**
118	32.62	6.04	26.58	**12.08**
119	31.40	4.73	26.67	**12.12**
120	31.50	4.78	26.72	**12.14**

Note: Cylinders were filled to the rim (not including fittings) with water and weighed on a 125-lb capacity platform balance.

Water density at room temperature = 0.997 gm/cc or 0.0022 lbs/cc.

Pitot Tube Calibration Data Sheet

Calibrated by: [illegible signature]

Date: 12-30-93

Pitot Tube I.D. S-17A

Effective Length: 5'

Pitot Tube Assembly Level ? ☑ Yes ☐ No

Pitot Tube Openings Damaged ? ☐ Yes ☑ No

If Yes, Explain ______

α_1 = 0 °(<10°) α_2 = 0 °(<10°)

β_1 = 0 °(<10°) β_2 = 0 °(<10°)

γ = 0 ° θ = 0 ° A = 0.954 °

Z = A sin γ = 0 cm (in.) 0.32 cm (<1/8 in.)

W = A sin θ = 0 cm (in.) 0.08 cm (<1/32 in.)

P_A = 0.477 cm (in.)

P_B = 0.477 cm (in.)

D_t = 0.375 cm (in.)

Comments: ______

Calibration Required ? ☐ Yes ☐ No